REPORT RESUMES

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FIRE SERVICE TRAINING, INSTRUCTOR'S MANUAL, BASIC COURSE.
BY- BERNDT, WILLIAM M. AND OTHERS
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DESCRIPTORS- *TEACHING GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *FIRE FIGHTERS, ADULT VOCATIONAL EDUCATION, *ANSWER KEYS,

INSTRUCTORS CAN USE THIS MANUAL IN CONDUCTING A 34-HOUR FIRE STATION OR TRAINING CENTER EXTENSION PROGRAM TO IMPROVE THE COMPETENCIES AND SKILLS OF LOCAL FIRE PERSONNEL IN THE SPECIALIZED FIELD OF FIRE SERVICE. IT WAS DEVELOPED BY A STATEWIDE COMMITTEE OF FIRE FIGHTING CONSULTANTS AND ADVISORY GROUPS. THE 26 TEACHING GUIDES PROVIDE INSTRUCTIONAL PLANS TO BE UTILIZED IN GROUP INSTRUCTION AND ARE KEYED TO THE FIRE SERVICE TRAINING INSTRUCTIONAL MATERIALS MANUAL (VT 000 721) AND THE LEARNER'S WORKBOOK (VT 000 723). EACH PRESENTS THE LESSON OBJECTIVES, TEACHING AIDS, AND INSTRUCTOR'S NOTES WHICH ARE SUBDIVIDED INTO THE FOUR-STEP INSTRUCTIONAL METHOD OF PREPARATION, PRESENTATION, APPLICATION OR TRYOUT, AND CHECKING AND FOLLOWUP. SOME OF THE GUIDES ARE (1) COMMUNITY FIRE DEFENSE, (2) WATER AS USED IN FIRE FIGHTING, (3) FIRE PUMPS, (4) LADDERS, (5) RESCUE, (6) POST-MORTEM CONFERENCE, (7) INSPECTIONS, AND (8) RADIATION HAZARDS. THE INSTRUCTOR MUST BE A QUALIFIED FIREMAN AND SHOULD FIT THE COURSE TO THE FIRE PROTECTION NEEDS AND EQUIPMENT OF THE PARTICULAR FIRE DEPARTMENT. TEACHING SUGGESTIONS, A BIBLIOGRAPHY, AND ANSWERS TO THE ASSIGNMENT SHEETS IN THE LEARNER'S WORKBOOK ARE INCLUDED. THIS DOCUMENT IS AVAILABLE FOR $4.00 FROM OHIO TRADE AND INDUSTRIAL EDUCATION SERVICE, INSTRUCTIONAL MATERIALS LABORATORY, THE OHIO STATE UNIVERSITY, 1885 NEIL AVENUE, COLUMBUS, OHIO 43201. (HC)

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FIRE SERVICE TRAINING

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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INSTRUCTOR'S MANUAL – BASIC COURSE

OHIO TRADE AND INDUSTRIAL EDUCATION SERVICE

DIVISION OF VOCATIONAL EDUCATION
STATE DEPARTMENT OF EDUCATION
COLUMBUS, OHIO

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MEMORANDUM

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TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) W. F. STOVER (Agency) INSTRUCTIONAL MATERIALS LABORATORY

(Address) 1885 Neil Avenue, Columbus, Ohio 43210

DATE: November 6, 1967

RE: (~~Author~~, Title, Publisher, Date) FIRE SERVICE TRAINING INSTRUCTOR.S MANUAL – BASIC COURSE, Ohio Trade and Industrial Education Service Instrcutional Materials Laboratory, Columbus, Ohio 43210 – Copyright 1963

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Development Group State consultants for fire fighting and advisory groups
Level of Group State wide committee
Method of Design, Testing, and Trial Developed by state consultants who are subject matter specialists

(3) Utilization of Material:
Appropriate School Setting Adult classes – Fire stations or Training Center
Type of Program Extension training for persons employed in fire fighting
Occupational Focus Special occupation
Geographic Adaptability International
Uses of Material Instructor's guide
Users of Material Instructor teaching extensive courses in firemgnship

(4) Requirements for Using Material:
Teacher Competency Experienced and qualified fireman
Student Selection Criteria Persons should be employed on full time or volunteer basis as firemen
Time Allotment

Supplemental Media --
Necessary *
Desirable
(Check Which)

Describe Fire Service Training
Fire Service Training Learner's Workbook – Basic Course
Source (agency) Instructional Materials Laboratory
(address) 1885 Neil Avenue, Columbus, Ohio 43210

Preface

The State Department of Education has been instrumental in providing trade and industrial training to the citizens of Ohio since 1918, originally through its State Board for Vocational Education and presently through the Trade and Industrial Education Service of the Division of Vocational Education.

Training in trade and industrial education enables young men and women to prepare for initial employment in trade or industrial occupations. In addition, it enables adults who are already employed to upgrade themselves and advance in their chosen occupations, and retrains those who are temporarily unemployed.

In the adult category, training is also provided for public service personnel such as fire fighters, rescue and emergency personnel, peace officers, school bus drivers, custodial employees, hospital housekeepers and electric linemen. The purpose of this training is to upgrade the service rendered to the general public by increasing and providing additional skills and/or knowledge.

In the field of public service occupations, Ohio can be truly proud of the aid given local communities for the training of their volunteer and paid fire fighters, including the industrial brigade fire fighters, by the Trade and Industrial Education Service. The training received by local firemen has certainly increased their operating efficiency and no doubt has saved countless lives and thousands of dollars in property losses since the program started in 1939.

It has long been the policy of the Trade and Industrial Education Service of the Division of Vocational Education, whenever possible, to utilize the personnel and services of the universities and colleges of the state and local boards of education in providing needed training in the local communities. We appreciate the services of Kent State University, University of Cincinnati, The Ohio State University, University of Toledo, and the many local boards of education who for many years have cooperated with the Division of Vocational Education in providing fire department training to hundreds of communities in the State of Ohio.

E. E. Holt, Superintendent of
Public Instruction

Byrl R. Shoemaker
Director of Vocational Education

Foreword

The Trade and Industrial Education Service, Division of Vocational Education, has sponsored a program of fire department training since 1939. The training, over a period of 23 years, has been presented to 64,800 paid and volunteer fire fighters in 2,061 training classes in the State of Ohio.

The objectives of fire service have not changed greatly over the last decade. Increased emphasis, however, has been placed upon them in view of mounting fire losses in life and property throughout Ohio and the nation. The primary objectives of this training program as they apply to the local community are as follows:

1. To determine local, county, regional and state needs and to implement a program to adequately meet these needs on a continuing basis.
2. To improve the competencies and skills of local fire personnel in the specialized field of fire service.

The state supervisor and the fire service training coordinators of the Trade and Industrial Education Service utilize the services of the State Fire Service Advisory Committee in order to effectively achieve the above-stated objectives and to determine the principles and policies of the fire service training program and the manner in which it is conducted in Ohio. This advisory committee is composed of representatives of international and statewide organizations interested in fire protection and fire fighting. The organizations represented are as follows:

Association of Ohio Fire Fighters

Fire Marshal's Office

International Association of Fire Fighters

Ohio Fire Chiefs Association

Ohio Inspection Bureau

Ohio State Firemen's Association

A comprehensive training program in all areas of fire fighting is currently in effect. The following types of training are now being conducted:

Basic Training

Advanced Training

Officer Leadership Training

- Human Relations
- Conference Leadership
- Effective Speaking
- Instructor Training

Industrial Brigade Training

Emergency and Rescue Training

Radiation Hazards Training

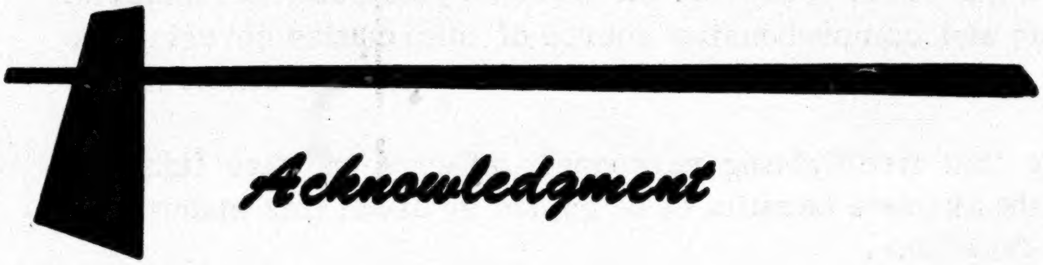
Special Training

- Regional Fire Schools
- State Fire School
- Fire Prevention
- Arson Detection
- Public Service Employees

The intent of this revised manual is to provide the necessary instructional material which will serve as an up-to-date and comprehensive source of information covering the practices and techniques of fire fighting in order to conduct an effective and efficient fire service training program.

It is our sincere desire that fire fighting personnel, officers and fire fighters, throughout the state will realize the ultimate benefits to be gained by use of this manual and adaptation of it to local training situations.

Harry F. Davis, Supervisor
Trade and Industrial Education Service



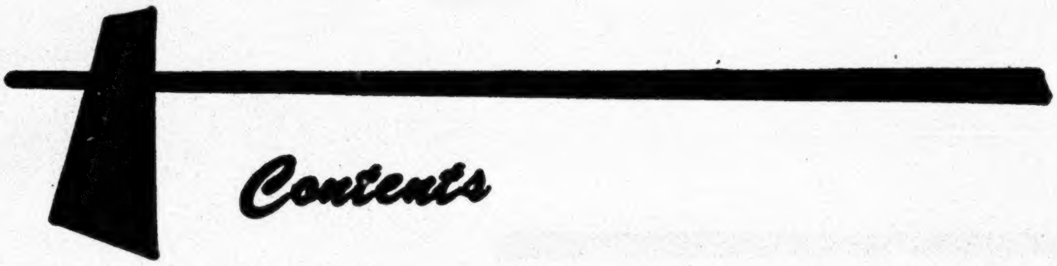
Acknowledgment

The Fire Service Training text contains the acknowledgment to the Trade and Industrial Education Services staff personnel, the State Advisory Committee, educational institutions, fire associations, organizations, and manufacturers who made a contribution to the text with which this Instructor's Manual is correlated.

Acknowledgment for the content of this Fire Service Training, Instructor's Manual-Basic Course is extended to the Fire Service Training Coordinators of the Ohio Trade and Industrial Education Services. They are as follows: Charles J. Getz, Kent State University; W. Joseph Heinzen, The Ohio State University; Harry A. Ohlrich, University of Cincinnati; and former staff member Elmer W. Weis, The Ohio State University.

Special mention is extended to the staff of the Instructional Materials Laboratory, Trade and Industrial Education Services; and to William M. Berndt, Consultant, Instructional Materials Laboratory, for directing and coordinating the development and production of this manual.

Harry F. Davis, Supervisor
Trade and Industrial Education Services



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To the Instructor

The Fire Service Training Basic Course consists of three separate publications: the Fire Service Training text; the Fire Service Training, Learner's Workbook - Basic Course; and the Fire Service Training, Instructor's Manual - Basic Course. The textbook is also used for the Advanced Course since the content is considerably beyond the Basic Course content.

This Instructor's Manual consists of a series of Teaching Guides which were prepared to serve as a plan or roadmap for the instructor when utilizing the group instruction method in teaching this course. The Teaching Guides are an indispensable aid to the new instructor and will serve as a valuable outline to the experienced instructor. Space is provided in the left column on each page of the Teaching Guides for additional notes which you may desire to add.

THE STARTING POINT

In order for your instruction to be of maximum value and as meaningful as possible, it is important to fit the course to the needs of the particular fire department in regards to its fire protection needs and equipment. The first step is for you, as the instructor, to determine the course content by conferring, in the organizational meeting, with the officers of the particular department that is to receive the training. As a result the prior selection of the course content will result in the most needed and effective training program for the learners.

The following suggestions will assist in determining what is to be taught, namely the course content:

- A study of the community to determine its fire protection needs.
- Determine by a survey the available apparatus and equipment.
- Determine the amount of instruction and practicing of evolutions that can be allotted in relation to the time available for each subject and the overall time of the entire course.
- Determine if there is competent help within the group to assist with subjects where practice is involved, such as: rope, gas masks, evolutions and etc.

PROPER PREPARATION

Each Teaching Guide is sub-divided into the "four step" method of instruction, as illustrated on page xiii of this manual. In presenting each teaching unit contained in each Teaching Guide utilize the four step method, namely: Preparation Step; Presentation Step; Application or Tryout Step; and Checking and Follow-up Step. Utilizing this method of instruction will result in the best possible instruction. In group instruction situations the following suggested procedures have proven quite successful and it is recommended that the instructor consider them carefully:

- The instructor should provide or make necessary provisions for materials, equipment, and supplies prior to the class session.
- Introduce the lesson (Step I) in an interesting and inspiring manner.
- Present the lesson (Step II) utilizing the teaching aids as listed in each Teaching Guide, and any others, such as: movies, charts, models, cutaways, and etc., which will assist in effectively teaching the content. Each instructor is encouraged to develop specialized teaching aids for his instructional use.
- Have learners perform and practice (Step III) the various evolutions and skills that are applicable, as indicated in the Teaching Guide. Also have the learners complete the appropriate assignment sheet in the Learner's Workbook which is correlated with each Teaching Guide. The assignments serve not only as a valuable aid to the learner, but also indicate to the instructor how well the lesson was taught.
- Check the assignment sheets (Step IV). The answers to the assignment sheets are contained in the appendix of this manual. Record learners' completion of assignment sheets. Reteach any portion of lesson that was not thoroughly understood.

THE CLASS SESSION

The class session should run smoothly and follow a definite pre-arranged pattern or plan. The following suggested procedure has proven quite successful:

- ► Take attendance and make announcements.
- ► Instructor presents the lesson as outlined in the Instructor's Manual. The step-by-step procedure should be followed so that all "key" points will be covered.

► Have learners participate by practicing those evolutions or skills indicated in the Teaching Guide. Caution: Do not devote an excessive amount of time to this, so that sufficient time is available for presenting the balance of the lesson.

► Answer learners' questions and discuss items not clearly understood.

► Utilize one of the following suggested methods for learners' use of the assignment sheets: learners work out assignment sheets in class; learners work out assignment sheets before coming to class and before formal lesson is presented; or learners work out assignment sheets after class (the latter may be the most practical method due to the amount of subject matter to be presented in the limited time available).

► Assignment sheets should be handed in for corrections. If so, they should be returned at the next class session and any points not fully understood should be reviewed and discussed. Announce topic for next class session and make assignments, as appropriate, including any necessary materials or equipment the learners are to bring to next class.

► Plan to leave suggestions in writing with the department, after each session, that will tend to increase the department's efficiency.

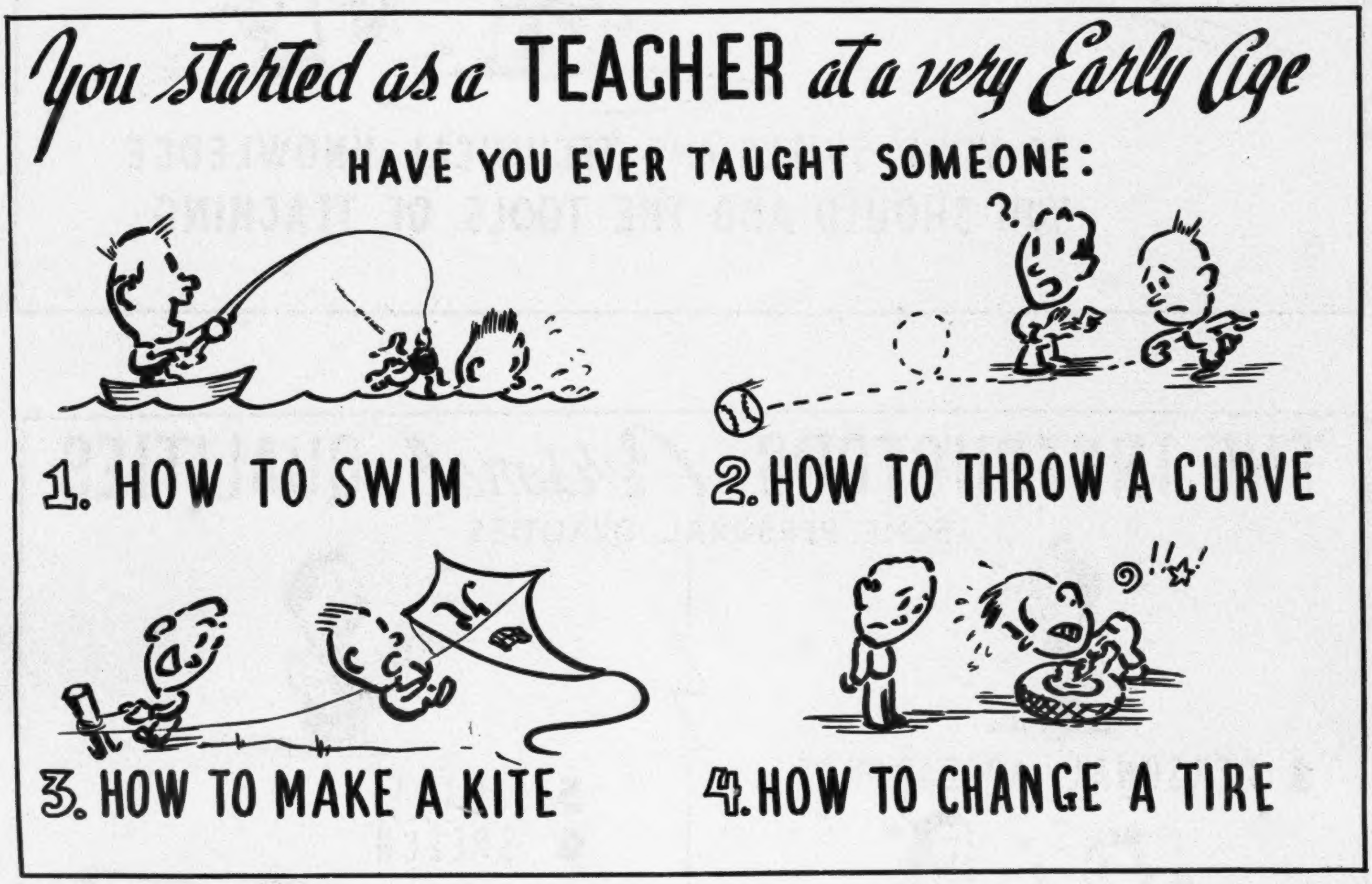
KEY FOR USING THE INSTRUCTOR'S MANUAL

The Teaching Guides in this Instructor's Manual are keyed for your convenience and to readily assist your instruction. In addition to the information presented and the suggestions for its presentation, space has been provided in the left margin on each page of the Teaching Guides for you to "pencil in" notes. Such notes will assist you immeasurably in elaborating and adding clarifying information of your own. The keying of the Teaching Guides are as follows:

Plain typing	-	Instructor says in his own words
Italics	-	Instructions to the instructor
CAPITALS	-	Key words, such as EXPLAIN, SHOW, and etc.
"Quotation marks"	-	Definitions to be read verbatim
Material in box	-	Place on chalkboard or chart pad

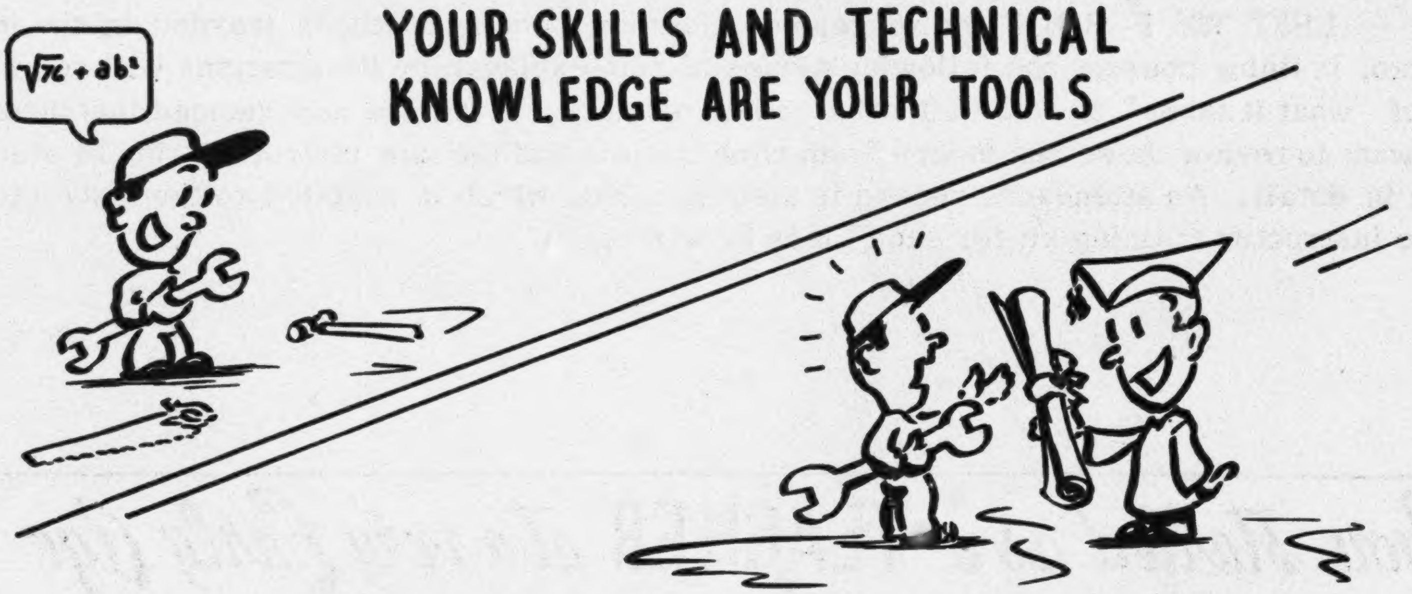
SUGGESTIONS FOR TEACHING

LEST WE FORGET the suggested effective teaching methods learned in the instructor training course, the following series of self-explanatory illustrations will remind you of "what it takes" to do an effective job of teaching. Even the experienced instructor will want to review these reminders from time to time and the new instructor should study them in detail. An attendance record is also included, which is supplied to the instructor in the instructor training kit for each class he will teach.


You Started as a TEACHER at a very Early Age
HAVE YOU EVER TAUGHT SOMEONE:
1. HOW TO SWIM
2. HOW TO THROW A CURVE
3. HOW TO MAKE A KITE
4. HOW TO CHANGE A TIRE

TEACHING *as a* NEW JOB

YOUR SKILLS AND TECHNICAL KNOWLEDGE ARE YOUR TOOLS



TO YOUR SKILLS AND TECHNICAL KNOWLEDGE YOU SHOULD ADD THE TOOLS OF TEACHING.

THE INSTRUCTORS *Personal* QUALITIES

SOME PERSONAL QUALITIES

1 PERSONAL APPEARANCE

2 COURTESY
3 SELF CONTROL
4 TACT

5 VOICE
6 SPEECH

7 CHEERFULNESS
8 ENTHUSIASM

YOUR PERSONALITY REFLECTS YOUR PERSONAL QUALITIES

The FOUR STEP LESSON

STEP I

PREPARATION OR INTRODUCTION STEP.

STEP II

PRESENTATION STEP.

STEP III

APPLICATION OR TRY OUT STEP.

STEP IV

CHECKING TESTING *and* FOLLOW UP STEP.

KINDS OF *Oral* QUESTIONS

INFORMATION QUESTIONS– *call for information.*

Example: What materials are used in this extinguisher, John?

THOUGHT QUESTIONS– *require thinking and judgement.*

Example: Why is it dangerous and unsafe to use a soda acid extinguisher on an electrical fire?

SUGGESTIVE QUESTIONS–*suggests answer "yes" or "no" or directs thinking.*

Example: Is it true that this extinguisher derives its name from the fact that soda and acid are used to charge it?

Example: Now since we have taken care of the soda solution, what else goes in the shell?

COMPARISON QUESTIONS–*calls for all kinds of comparisons.*

Example: Compare stellite and high speed steel as a cutting tool.

Methods OF ASKING QUESTIONS ?

THERE ARE TWO METHODS:

1 **DIRECT** ***Directed to a member of the class; ask question first, direct it last.***

Example: How many degrees are there in a right angle, *John?*

---

2 **OVERHEAD** ***Directed to the entire class.***

Example: Why is it necessary to lubricate the dead center of a lathe?

DIRECT METHOD

Advantages:

1 *Stimulates thinking of all members of the class.*
2 *Tends to strengthen group control.*

Disadvantages:

1 *Tends to slow up the lesson.*
2 *Tends to destroy confidence of timid learners.*

OVERHEAD METHOD

Advantages:

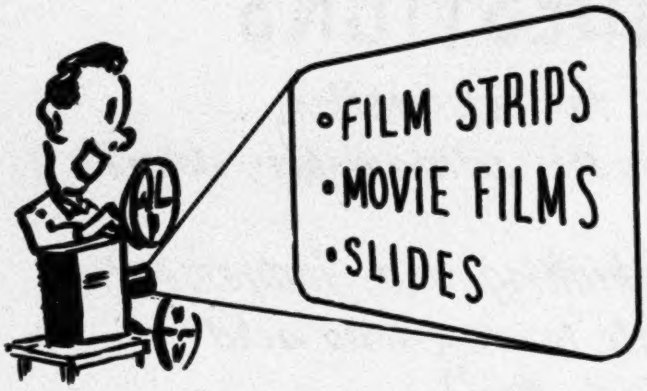
1 *Tends to speed up the lesson.*
2 *Ideal for preparation step.*

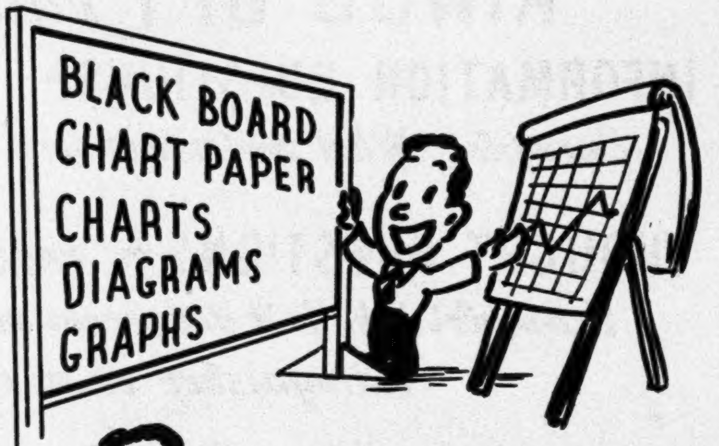
Disadvantages:

1 *Tends to destroy group control.*
2 *Discourages thinking of less diligent learners.*

FOLLOW THE RULES ON ORAL QUESTIONS

TEACHING AIDS



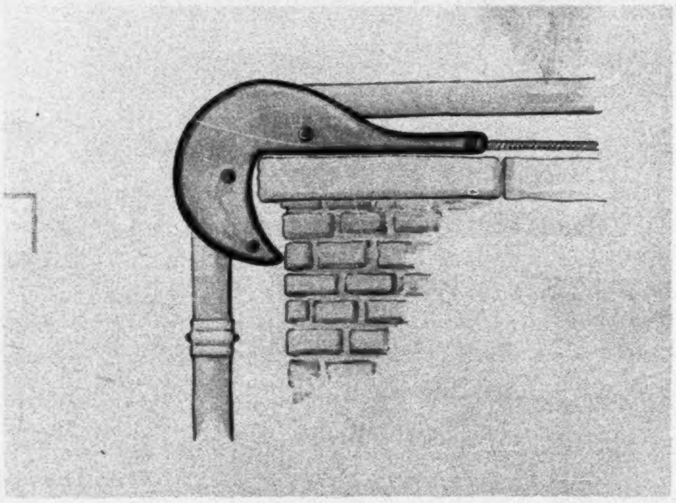


MODELS *and* MOCK-UPS

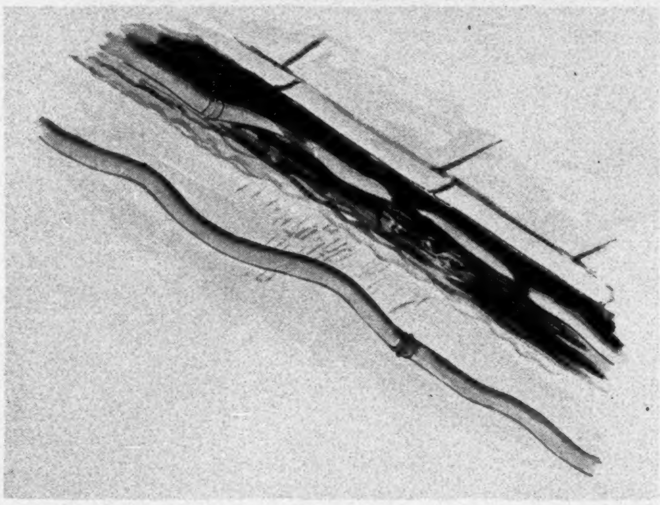
INSTRUCTIONAL MATERIALS
- INSTRUCTION SHEETS
- TEXT BOOKS
- SERVICE MANUALS

SAMPLE TEACHING AIDS

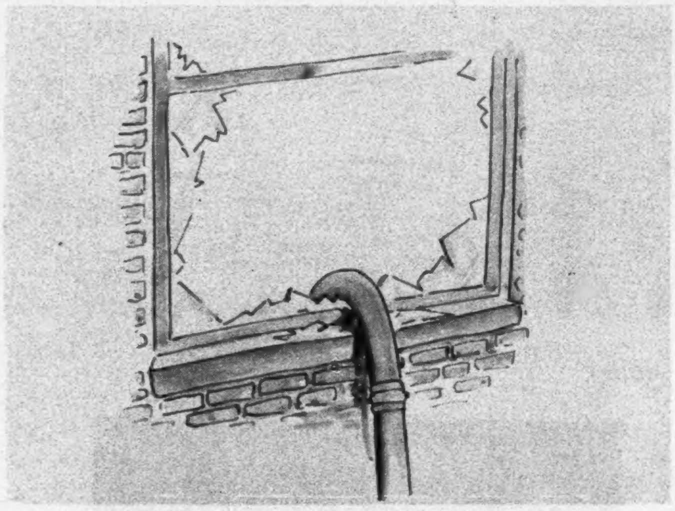
Teaching aids are of great assistance in Step II, Presenting the Lesson. The following examples of charts, along with many others, can be developed and drawn by the instructor. They may also be made into 2" x 2" slides and when a series of these are developed they can be used repeatedly for effective instruction.



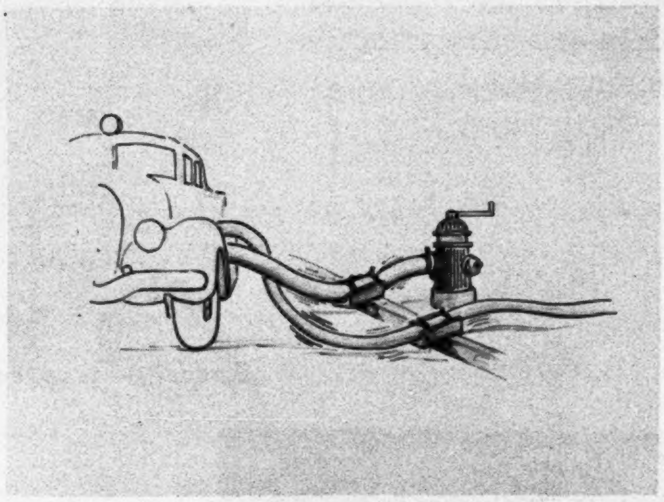
Hose rollers



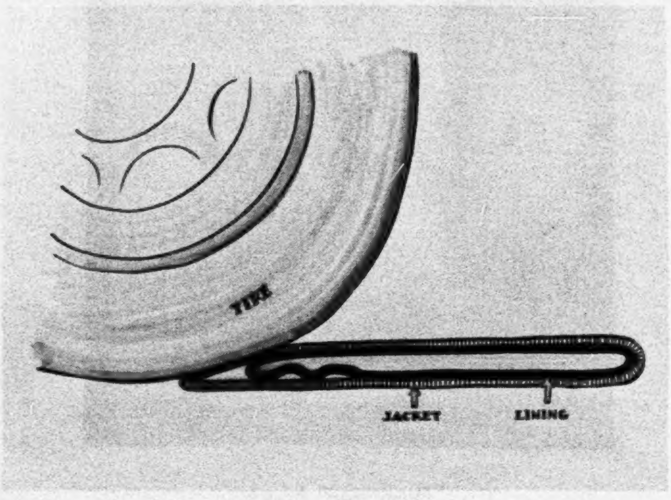
Hose in gutter



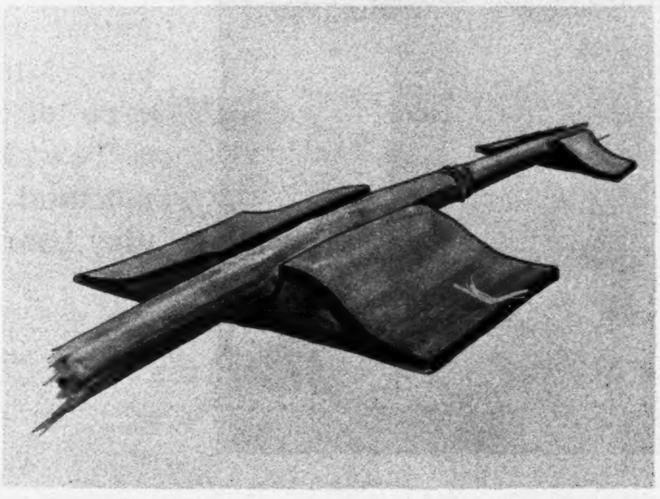
Hose Going Through Window



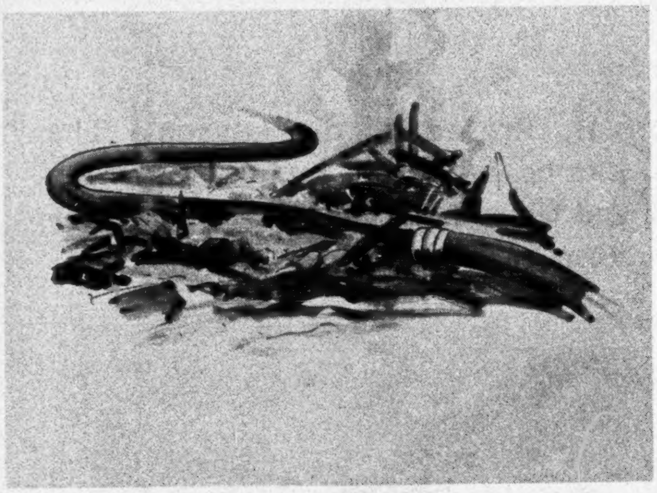
Picture showing vibration



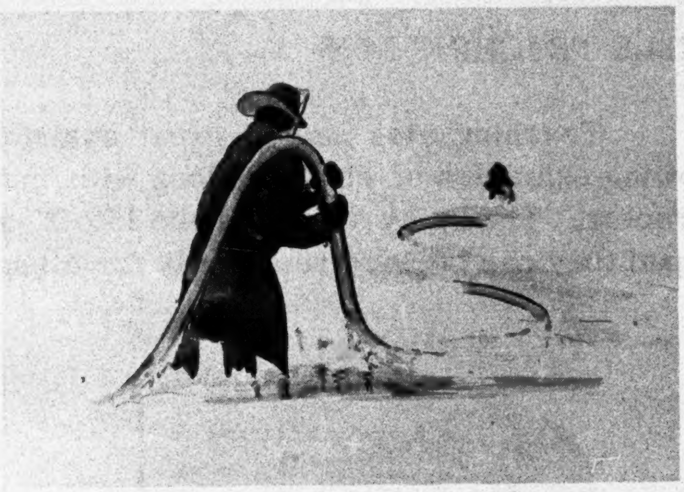
Driving over hose



Hose blocks

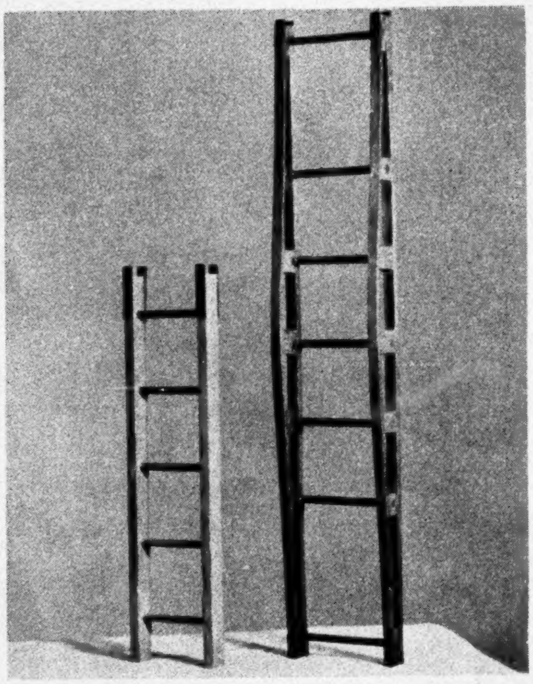


Hose being burned

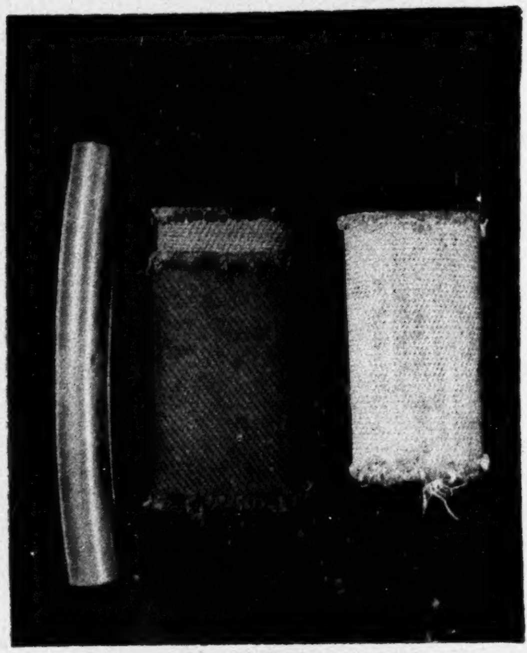


Handling of frozen hose

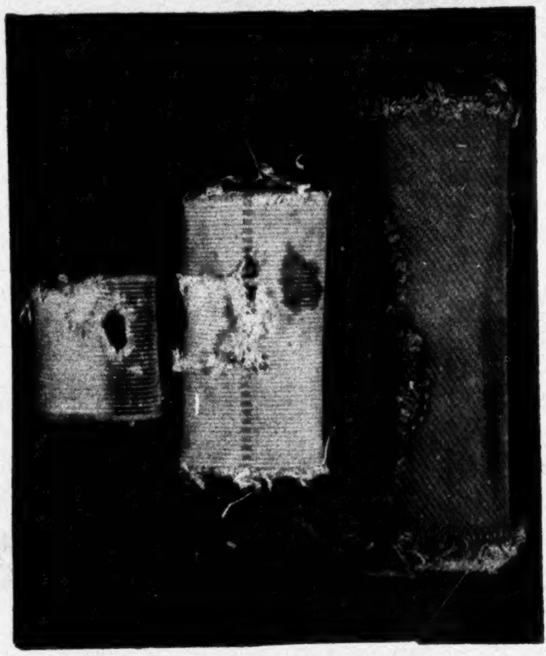
The picture on the right shows an example of good utilization of models. Models are very effective Teaching Aids.



Ladder - trussed and beam ladder



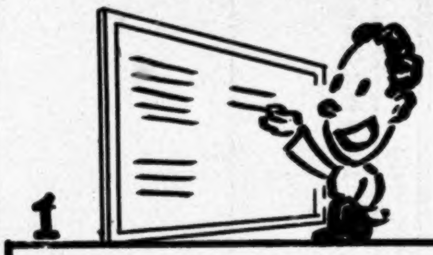
Actual samples of materials can be very effective as a Teaching Aid mounted on a display board.



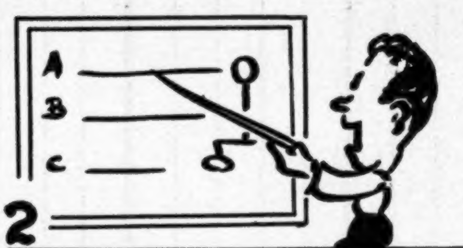
Types of hose

Damaged hose

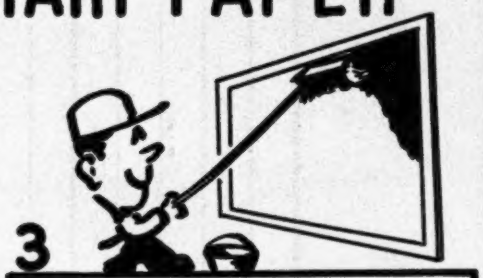
THE BLACKBOARD OR CHART PAPER



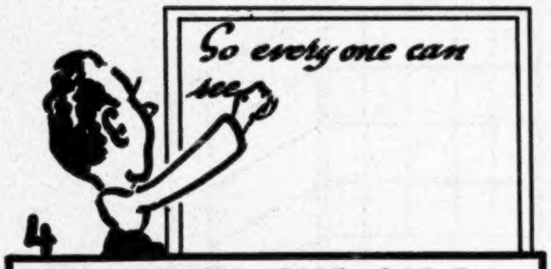
1 WRITE LEGIBLY *and* ARRANGE NEATLY.



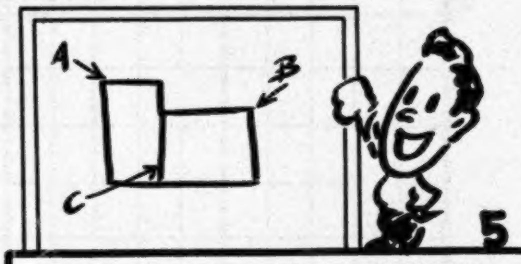
2 STAND TO ONE SIDE WHEN USING THE POINTER



3 KEEP BLACKBOARD CLEAN.


So every one can see

4 STAND TO ONE SIDE WHEN WRITING.



5 USE FOR SKETCHES DIAGRAMS OUTLINES *etc.*

YOUR *Management* RESPONSIBILITIES

① GOOD HOUSEKEEPING

② HEAT, LIGHT AND VENTILATION

③ SAFETY

④ GROUP CONTROL

⑤ RECORD KEEPING

⑥ SEATING

OHIO TRADE AND INDUSTRIAL EDUCATION SERVICES
ADULT EXTENSION CLASS

ATTENDANCE RECORD

Course ______________________ City ______________________

	ENROLLMENT			DATE OF MEETINGS																					
No.	Last Name — First Name	M	F																					Total Hours Attendance	Certificate Due
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
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18																									
19																									
20																									

Total Enrollment ______ Females ______ Number of Class Sessions ______ Total Hours for Course ______

Average Attendance per Meeting ______ Number of Hours per Session ______ Signed ______________________

(Instructor)

TEACHING GUIDE #1

COMMUNITY FIRE DEFENSE

OBJECTIVES:

1. To become familiar with modern concepts and responsibilities in the safeguarding of life and property.
2. To learn the various ramifications of Grading Schedules.
3. To become familiar with personnel qualifications, public relations, and a record system necessary in the operation of a well organized fire department.
4. To learn the necessity for mutual aid and disaster planning.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Grading Schedules information:
   a. National Board of Fire Underwriters
   b. Ohio Inspection Bureau Specifications
   c. Ohio Inspection Bureau Fire Defenses
3. Available record forms (samples)
4. Available report forms (samples)

REFERENCE:

Fire Service Training (text), Chapter 1, pp. 1-20.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Fire Protection can be a rather ambiguous term when used in connection with the safeguarding of life and property. As we all know, fire fighting apparatus and equipment alone will not guarantee immunity from fire. The well organized modern and up-to-date fire department realizes there are many factors concerned in an overall community fire defense plan of operation aimed to secure maximum protection for its citizens.

Fire department officials should be aware of these factors in order to perform their duties and responsibilities in an efficient and capable manner.

Knowing and carrying out the responsibilities will no doubt demonstrate and provide to the people in the community the important fact that the fire department is vitally interested and concerned in their safety and welfare.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. GRADING SCHEDULES
  1. Classified as Urban and Rural
     REFER learners to Table 1 and 2, p. 2, Fire Service Training (text) and DISCUSS.
  2. Urban Grading Schedule
     a. Water supply
        (1) An adequate and reliable water supply is essential
           (a) To supply normal needs of citizens
           (b) To supply fire department needs
     b. Fire department
        (1) The items of most importance are:
           (a) Personnel
           (b) Apparatus, tools, and equipment
           (c) Hose and hose stream appliances
           (d) Radio communications
           (e) Training
           (f) Fire methods (fire fighting techniques)
           (g) Building inspections
           (h) Record systems
     c. Structural conditions
        (1) The most important items are:
           (a) Street widths
           (b) Heights of buildings
           (c) Wall and floor openings
           (d) Areas of wood (frame) or unprotected construction
           (e) Conflagration breeding blocks
     d. Fire alarm system
        (1) Twenty-three items are included in this list, the most important ones are:
           (a) Headquarters
           (b) Operators
           (c) Current supply
           (d) Box location
           (e) Fire alarm boxes
           (f) Radio
           (g) Telephone
           (h) Tests and records
     e. Fire prevention
        (1) Seven items relate to this grading schedule
           (a) Electrical wiring and equipment
           (b) Establishment and enforcement regulations of the bureau

Instructor's Notes

- (c) Control of miscellaneous hazards
- (d) Manufacture, storage, transportation, and use of liquid gases
- (e) Enforcement agency for fire prevention
- (f) Electrical and fire prevention records

f. Building department
  - (1) The five items included in this area are:
    - (a) Supervision
    - (b) Fire limits
    - (c) Adequacy and enforcement of building laws
    - (d) Roof coverings
    - (e) Records

g. Police department
  - (1) This area includes the following three items:
    - (a) Cooperation with the fire department
    - (b) Signalling and emergency service
    - (c) Cooperation with building department

3. Rural Grading Schedule
   - a. Water supply
     - (1) Public water supply system
       - (a) If available, grading is the same as for an urban water supply
     - (2) Where no public water supply system is available, two ratings are established by the Ohio Inspection Bureau for:
       - (a) Farm property
       - (b) Dwelling and mercantile property

B. SPECIFICATIONS FOR CLASS A RURAL FIRE DEPARTMENT

***DISCUSS** the following items:*

1. Fire department
2. Fire station
3. Records
4. Clothing
5. Apparatus

C. SPECIFICATIONS FOR CLASS B RURAL FIRE DEPARTMENT

***DISCUSS** the following items:*

1. Fire department
2. Fire station
3. Records
4. Clothing
5. Apparatus

***COMPARE** and **DISCUSS** the differences between specifications for Class A and Class B rural fire departments.*

Instructor's Notes

6. Other important factors to be considered by fire departments in rural areas in planning community fire defense.
   a. Structural conditions
      (1) The same items are included in rural as in urban
   b. Fire alarm
      DISCUSS in terms of Ohio Inspection Bureau Specifications for
      (1) Class A and Class B rural fire departments
   c. Fire prevention
      (1) Rural inspection program
      (2) Local ordinances
      (3) State Building Code
      (4) State Rules and Regulations
   d. Building department
      (1) State Building Codes
      (2) County Building Codes
      (3) State Department of Industrial Relations bulletins on special requirements concerning building construction
   e. Police department
      (1) Relate practices and working agreements in effect by local law enforcement agency

E. ADDITIONAL FACTORS IN COMMUNITY FIRE DEFENSE

Up to this point in the lesson we have been concerned with mainly the physical or mechanical aspects of Community Fire Defense. Now let us explore and develop other areas of fire defense that deal with humanities. They are as follows:

1. Selection of Fire Department Personnel
   READ the twelve items as listed in the text, pages 8 and 9, and DISCUSS each in turn. It is probable that other qualifications may be listed or brought up for discussion.
2. Public Relations
   a. Necessity for and importance of good public relations
   b. Will affect morale of department
   c. Action of one fireman will reflect on entire department
   d. Dependent on capable and well trained personnel
      (1) In order to receive moral and financial support
   e. Responsibility of each individual fireman
   f. Begins within the department itself
   g. Effected by firemen's contacts with public in performing various duties
3. Mutual Aid
   a. Stress importance of mutual aid

Instructor's Notes

(1) Strenthens fire fighting facilities in communities participating

b. Dependent on well thought out and laid out plan in order to be effective

c. Factors to be considered in organizing a mutual aid plan:

- **(1) Signaling or notification system**
- **(2) Apparatus responding**
- **(3) Manpower available**
- **(4) Running cards**
  - **(a) Fire scene**
  - **(b) Stand-in**
- **(5) Availability of radio**
- **(6) Equipment available**
- **(7) Hose couplings and adapters (matching threads)**
- **(8) Water supply**
  - **(a) Water system**
  - **(b) Portable (Tanker)**
- **(9) Authority to call for aid**
- **(10) Distance responding**
- **(11) Time of travel**
- **(12) Cooperation of assisting organizations**
  - **(a) Law enforcement agencies**
  - **(b) Public utilities**
  - **(c) Public service department**
  - **(d) Construction companies**

DISCUSS one mutual aid plan now in effect. If this training class consists of members of more than one department, have each class member study their own plan.

4. Emergency Disaster Planning

DISCUSS general need for emergency disaster planning.

a. Fire department has the responsibility to promote and develop an emergency disaster plan but requires cooperation from the following agencies:

- (1) Electric, gas and telephone companies
- (2) Excavating or road equipment service
- (3) Radio and television stations
- (4) Red Cross
- (5) Hospitals, doctors and nurses
- (6) Sheriff's office
- (7) Highway patrol
- (8) Municipal or county service departments
- (9) Radiation monitoring service

b. An effective emergency disaster plan will promote good public relations

- (1) Good organization is the key factor

Instructor's Notes

5. Fire Department Records
   - a. Comprehensive records are an essential part of good fire department operations
   - b. Extensiveness of record system will be dependent on:
     - (1) Size of the fire department
     - (2) Adequacy of personnel to maintain records
   - c. Department files should consist of the following:
     - (1) Complete personnel file
     - (2) Sick or absentee file
     - (3) Confidential personnel file
     - (4) Inactive members file
     - (5) Department correspondence file
     - (6) Payroll, invoices, etc. file
     - (7) Assignment chart file
     - (8) Master fire report book
   - d. Company records should consist of the following:
     - (1) Company journal
     - (2) Vacation and work schedule
     - (3) Addresses and telephone numbers of company personnel
     - (4) Inventory and special notices book
     - (5) Fire report sheets and hazard inspection blanks
     - (6) Emergency run data
   - e. Training Officer's records
     - (1) Daily drill schedule
     - (2) Drill attendance record
     - (3) Equipment inventory
     - (4) Reference library record
   - f. Repair shop records
     - (1) Apparatus and maintenance record
     - (2) Hose records
     - (3) Equipment inventory
     - (4) Parts supply inventory
     - (5) Shop personnel time sheets
     - (6) Pumper test records
   - g. Fire Prevention Bureau Records
     - (1) Correspondence file
     - (2) Inspection schedule file
     - (3) Inspection blank file
     - (4) Building plans file
     - (5) Arson file
     - (6) Cross-file record

6. Fire Department Records and Reports

   ***EMPHASIZE** the importance and necessity of using report forms as a means for establishing a good record system for the fire department. Cite personal examples and experiences of your own.*

Instructor's Notes

a. One standard type of form cannot be devised which will fit the needs of every department.

b. Each department should devise their own forms to fit the specific information they wish to maintain and record

c. Responsibility of fire chief

(1) As to who will make reports

(2) How they will be expediated

EXAMINE briefly some of the various types of report forms that can be used in the operation of a fire department by referring learners to the following in Fire Service Training (text) and DISCUSSING each.

Page 14 - Fig. 1 - Daily Report Form
Page 15 - Fig. 2 - Daily Personnel Report
Page 16 - Fig. 3 - Disability Report
Page 17 - Fig. 4 - Training Report
Page 18 - Fig. 5-a and Page 19 - Fig. 5-b
Company Run Report
Page 20 - Fig. 6 - Dispatcher Report
Page 20 - Fig. 7 - Fire Report

d. It is apparent these reports cover only a small portion of the pertinent factors involved in fire department operation.

e. Even though facilities and shortage of personnel may be deterring factors in attempting to establish and maintain an adequate report and record system,

(1) every effort should be made to put into operation some kind of system that will

(a) that will be of value in efficiently structuring the over-all operation of the fire department

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 1 in the Learner's Workbook.

STEP IV - CHECKING AND FOLLOWUP:

REVIEW Assignment Sheet No. 1, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #2

CHEMISTRY OF FIRE

OBJECTIVES:

1. To emphasize to the learner that a knowledge of the chemistry of fire is an important factor in the development of an effective and well trained fire fighter.
2. To acquaint the learner with the characteristics of combustion and its direct relationship with the proper extinguishing methods and media.
3. To familiarize the learner with the explosive natures and properties flammable liquids, gases, and dusts from combustible materials.

TEACHING AIDS:

1. Chalkboard, chalk, eraser
2. Available charts or material relating to physical and chemical properties of flammable liquids and gases.
3. Demonstration materials:
   a. Flammable liquids - kerosene, gasoline and alcohol
   b. Combustible materials - wood, paper and metal
   c. Candle, beakers and covers

REFERENCE:

Fire Service Training (text), Chapter II, pp. 21-25.

Instructor's Notes

STEP I - INTRODUCING THE LESSON

Combustion or burning is defined as a chemical process accompanied by the evolution of heat. In terms of the role a fireman plays in the control and extinguishment of fire it becomes his obligation to know and understand this definition. Physically, a fireman is well aware of the fact that when a substance is burning, it gives off various degrees of heat, and exhibits a glowing mass. But in addition to his physical awareness, every fireman should be concerned with the process that produces the situation which he faces at the scene of the fire. In this process, we are specifically interested in the chemical union which takes place between the temperature, the fuel, and the oxygen. Upsetting this process by disturbing the relationship of these factors is the real key to proper and efficient fire extinguishment.

nstructor's Notes

STEP II - PRESENTING THE LESSON

A. HOW THINGS BURN

1. Solids
    a. Ignition of coal is accomplished by:
        (1) Building a wood fire
        (2) Wood must be ignited by paper
        (3) Paper must be ignited by match
        (4) By this series of processes, the burning of each material raises the temperature to the ignition temperature of the next material until the final material becomes ignited and burns
    b. Definition of ignition temperature (same as kindling temperature)–
        "The temperature at which a substance will catch on fire and continue to burn"
        (1) EXPLAIN that ignition temperature will vary for different materials
            (a) Phosphorous on match, by friction (86° F)
            (b) Sulphur, from small spark (450° F)
            (c) Carbon, to glowing temperature (690° F)
            (d) Magnesium, to high temperature (965° F)
        (2) EXPLAIN that another important factor involved in the ignition of a substance is the size, surface, or mass of the substance to be heated
            EXPLAIN and DEMONSTRATE the following:
            (a) Page of book vs. mass of whole book
            (b) Needle vs. bar of steel
            (c) Wood shaving vs. block of wood
    c. EXPLAIN that regardless of the material involved, it is necessary that a solid must first be heated sufficiently to cause it to change into a combustible gas before it will ignite
2. Flammable Liquids
    a. EXPLAIN that this same principle of the burning of solids also applies to flammable liquids
    b. Definition of flash point -
        "The temperature at which a flammable liquid gives off vapor sufficient to form an ignitable mixture with the air near the surface of the liquid"
        (1) The temperature will vary in accordance to the density of the liquid
            (a) EXAMPLE - Match thrown in cold kerosene vs. heated or gaseous kerosene
        (2) The danger of gasoline is the fact that it passes off combustible vapors at ordinary temperatures.

Instructor's Notes

c. EXPLAIN that liquids with a flash point lower than 200° F are considered flammable, but, any combustible liquid when heated above its flash point will produce flammable vapors
   (1) EXAMPLE - Heavy fuel oil when heated above 300° F will release vapors as flammable as gasoline at its flash point temperature which is below 0° F

d. EXPLAIN that flammable liquids are divided into three classes:
   (1) Class I - Flash Point at or below 20° F
   (2) Class II - Flash Point above 20° F - below 70° F
   (3) Class III - Flash Point above 70° F - below 200° F

e. EXPLAIN that flash point alone is not the only factor which determines the relative hazard of a flammable liquid. Other factors are:
   (1) Ignition temperature
   (2) Explosive range
   (3) Rate of evaporation
   (4) Density
   (5) Rate of diffusion

f. Regardless of all the factors which determine the ignition of a flammable liquid, they have little influence on the burning characteristics after the fire has burned long enough to thoroughly heat the liquid

g. RECOMMEND that additional data and information on flammable liquids and gases can be obtained from:
   (1) The National Board of Fire Underwriters
   (2) The National Fire Protection Association
   (3) The Division of State Fire Marshal
   (4) The Ohio Inspection Bureau
   (5) The Factory Mutual, or various other insurance companies

3. Spontaneous Ignition

a. Definition of spontaneous ignition - "It is caused by the gradual development of heat due to a chemical change within the material"

b. EXPLAIN - If the amount of heat generated by this chemical action is enough to reach the ignition temperature of the material involved, it will ignite the material
   (1) EXAMPLE - When cloths are soaked in linseed oil, the oil spreads over the surface of the cloth and absorbs oxygen.
      (a) If the heat from this action is not dissipated, the rate of oxidation is increased, thus raising the temperature, until it reaches the

Instructor's Notes

ignition temperature of the cloth, and causes it to burst into flame

4. Elements and Compounds
    - a. Definition of an element - "A substance which has not been separated into other substances"
    - b. Definition of a compound - "A substance that can be separated by chemical means into two or more substances"
    - c. For an element to burn, it must first unite with oxygen
    - d. For a compound to burn, each element in it must first unite separately with oxygen
    - e. Elements are classified as either metals or non-metals
    - f. Whenever a compound of carbon, hydrogen, oxygen, or nitrogen is oxidized, either by rapid burning or by the slower process of decay, the final result is the same
        - (1) EXAMPLE - When ordinary fuels, such as, wood or coal are burned, the result is carbon dioxide, and water vapor or steam
        - (2) Slower oxidation or burning which takes place when iron rusts, milk sours, or fruit decays, also results in carbon dioxide and water vapor
        - (3) Therefore, burning, whether it be rapid and accompanied by heat, or slow such as, by decay, is the final way of disposing of organic material
        - (4) The reason gasoline burns so readily and rapidly when heated, is because it is made up of two elements, carbon and hydrogen, and each of them has an affinity for oxygen
5. Smoke
    - a. Definition of smoke - "Smoke is the result of incomplete combustion
    - b. When a material burns, the heat of the fire expels hydrogen and oxygen along with carbon, which pass away as gases
        - (1) However, as these gases are burned they do not meet with sufficient oxygen and are consequently cooled in the process
        - (2) As the hydrogen burns off more rapidly, unburnt carbon is liberated as soot and carbon monoxide in the form of smoke
6. Air and Oxygen
    - a. Normally, air contains about 21% oxygen

- b. When the oxygen content is reduced below 16%, air will not support combustion and flame is extinguished
- c. In fire fighting, the percentage of oxygen around a flame can be reduced in two ways -
    - (1) Cutting off the oxygen by smothering
    - (2) Displacing the air with a non-combustible gas, such as carbon dioxide or water vapor (steam)
- d. However, oxygen does not necessarily have to be supplied by air
    - (1) It can be produced artificially in the combustion of chemicals such as:
        - (a) Chlorates, nitrates, thermite, etc.
        - (b) Pyroxylin plastics
        - (c) Decomposition of water upon contact with hot metals or coke, because the tremendous heat frees the oxygen and hydrogen

7. Summary of How Things Burn
    - a. Thus, we have learned that fire is a rapid chemical change in which combustible substances burn and give off heat
    - b. Substances which easily combine with oxygen to form new substances, and produce a high degree of heat in the process, are classed as combustibles
    - c. Three things are necessary to support combustion, they are:
        - (1) A combustible substance, FUEL
        - (2) Sufficient OXYGEN to support combustion
        - (3) Sufficient HEAT to ignite the substance
    - d. Therefore, when firemen are able to determine the characteristics of a fire, they can decide which method of extinguishment to use

B. EXPLOSIONS

1. Four Principle Kinds
    - a. Rapid oxidation (gasoline vapor, air and dust)
    - b. Decomposition (dynamite)
    - c. Release of pressure (boiler explosion)
    - d. Atomic fission (atomic bomb)
2. All Have Same Characteristics
    - a. Release of energy is substantially instantaneous
3. Force of an Explosion Depends on:
    - a. Rate of release of energy, more than upon amount of energy released
4. Firemen are Concerned with Fire Explosions Caused by Release of Heat Energy through Rapid Oxidation (as in 1a above)

Instructor's Notes

5. **No Sharp Distinction between:**
    a. **An explosion**
    b. **Rapidly spreading fire such as those in gasoline**
        (1) **Flash fire**
6. **Explosions Occur when:**
    a. **Flammable vapors, gases, or combustible dusts are mixed with air**
    b. **Proportions produce rapid oxidation**
    c. **Source of ignition is provided**
7. **Violence of Explosion Depends on Rate of Oxidation**
8. **Rate of Explosion can be Measured only by Special Instruments**
9. **Finely Divided Particles of nearly all Combustible Materials can Produce Violent Explosions if:**
    a. **Particles are suspended in air in proper concentrations**
    b. **Source of ignition is provided**
10. **Ignition of Dust Cloud is Governed by:**
    a. **Particle size**
    b. **Dust concentration**
    c. **Uniformity of dispersion**
    d. **Amount of impurities present**
    e. **Strength and duration of ignition source**
11. **Dust Concentration also has Explosive Limits**
    a. **Light, readily dispersible - 0.015 oz. per cu. ft. of air**
    b. **Heavy - 0.5 oz. per cu. ft. of air**
12. **Ignition of Dust Concentrations below 0.015 oz. per cu. ft. of air have been Reported**
13. **Minimum Explosive Concentrations and Ignition Temperatures of Dust Clouds**
    DISCUSS table on p. 23, Fire Service Training (text).
14. **Dust Explosions Usually Occur in Pairs**
    a. **First - involving dust in suspension**
    b. **Second - involving dust dislodged from beams, ledges, etc., as a result of first explosion**
15. **Intensity of Dust Explosions is Influenced by:**
    a. **Nature of dust**
    b. **Degree of confinement**
    c. **Amount of explosion venting provided**
16. **Explosions Have Been Most Prevalent in Grain Handling Plants, such as:**
    a. **Grain elevators**
    b. **Flour and feed mills**
    c. **Cereal plants**

Instructor's Notes

17. Explosion Hazard also Exists in Other Industries, such as:
    a. Starch manufacturing
    b. Sugar refining
    c. Woodworking
    d. Sulphur crushing and pulverizing
    e. Hard rubber recovery
    f. Cork grinding
    g. Metal powder plants
    h. Fertilizer plants
    i. Powdered milk plants
    j. Chocolate, cocoa and candy factories
    k. Plastic and textile plants
18. No Sharp Line of Demarcation between Flammable Liquids and Gases, as
    a. Liquids become gases at higher temperatures
    b. Gases become liquids at lower temperatures
19. Flammable Liquids Themselves do not Cause Fire,
    a. A spark or source of ignition must first be provided
20. Improper Use and Handling of Flammable Liquids Cause Many Fires
21. The Vapor Evaporated from a Flammable Liquid, Rather than the Liquid, Burns or Explodes When Mixed with Air in Proper Proportion When a Source of Ignition is Provided
    a. The greater the heat, the greater the evaporation
    b. Proper proportions of flammable liquid vapors and air are explosive
    c. Explosive range for gasoline is about 1% to 6% by volume
    d. One gallon of gasoline if completely vaporized and mixed with air will form explosive mixtures in volume from 500 cu. ft. to well over 2,000 cu. ft. of air
22. Definition of Explosive or Flammable Limit- "The point at which the concentration of a mixture of flammable liquid or gas in air by volume, in which a flash will occur or a flame will travel if the mixture is ignited"
    a. The lower percentage at which this occurs is the lower explosive limit
    b. The higher percentage at which this occurs is the upper explosive limit
    c. Mixtures outside these limits are either too "lean" or too "rich" to explode
    d. EXAMPLE - For gasoline the lower limit is slightly over 1% and the higher limit is about 6%

Instructor's Notes

23. Firemen Should Become Familiar with the Properties and Characteristics of the More Common Flammable Liquids and Gases to Enable Them to be:
    a. Aware of the potential fire hazard involved
    b. Apply proper and efficient fire fighting procedures
24. DISCUSS chart on Physical and Chemical Properties of Flammable Liquids and Gases, Fig. 1, p. 25, Fire Service Training (text)

Additional information relating to data in Figure 1 follows. Flash point, explosive limits and ignition temperature have been previously discussed in this teaching guide. The following information on specific gravity, density of vapor, boiling point, and rate of diffusion is submitted to assist in explaining Figure 1.

Specific Gravity - "The ratio between the weight of a body and the weight of an equal volume of water."

EXAMPLE - The specific gravity of iron is 7.4 meaning that an equal volume of iron is 7.4 times heavier than water. A cubic ft. of water weighs 62.5 lbs., therefore; a cubic ft. of iron will weigh 7.4 x 62.5 lbs. or 462.50 lbs. Gasoline is .75 as heavy as water, a cubic ft. of gasoline will weigh .75 x 62.5 lbs. or 46.875 lbs. Most all liquids are lighter than water, therefore; will float on top of water.

Vapor Density - "The ratio of a given volume of gas or vapor compared to the same volume of air." As shown on the table, Air = 1 - any vapor appearing on the table at less than one is lighter than air, and at a figure over 1 is heavier than air. Almost all vapors are heavier than air.

Boiling Point - All liquids posses a tendency to vaporize, meaning a change from a liquid state into a gaseous state. Such vaporization occurs because molecules are continually projected through the free liquid surface and lost from the body of the liquid. Such molecules, being gaseous, are capable of exerting a partial pressure, known as the "Vapor Pressure" of the liquid, and since this pressure is dependent primarily upon molecular activity, it will increase with increasing temperature.

EXAMPLE - The "vapor pressure" of water at 30° F is .08 of 1 lb. per sq. in., at 102° F 1 lb. per sq. in., at 212° - 15 lbs. per sq. inch.

For boiling to occur, a liquid's temperature must be raised sufficiently for the vapor pressure to become equal to the pressure imposed upon the liquid. This means the boiling point of a liquid is dependent upon its pressure as well as upon its temperature.

EXAMPLE - Atmospheric pressure at sea level as 14.7 lbs. per sq. in. When the temperature of water is raised to 212°F., the vapor pressure is 15 lbs. per sq. in., or greater than atmospheric pressure (the pressure being imposed on the body of water) allowing the molecules to break through the surface and escape from the liquid. Atmospheric pressure at an altitude of 6,000 ft. is 11.4 lbs. per sq. in. The vapor pressure of water at 200°F is 11.6 lbs. per square inch, therefore water will boil at a lower temperature at a higher altitude.

The boiling point of any liquid can be raised by imposing a higher pressure upon it, than atmospheric pressure. The pressure cooker is an example. By closing the cooker securely, the pressure may be raised to 20 lbs. - the temperature of the water can be raised to a point much higher than 212° resulting in the food being cooked in a much shorter time.

Suitable Extinguishing Agents: The extinguishing agents in the last column of the table are coded according to the following schedule: 1-Water, 2-Foam, 2A-Alcohol Foam, 3-Carbon Dioxide or Dry Chemical, and 4-Stop Flow of Gas. (See note).

Note: While carbon dioxide dry powder and sometimes water spray can extinguish small gas fires if the extinguishing medium is applied at the source of the fire, the best procedure is to shut off the source of gas. Extinguishment without shutting off the source of gas will permit unburned gas to accumulate creating a potential serious explosion hazard.

VAPOR PRESSURE OF COMMON LIQUIDS AT 68°F

		Boiling Point
Ether	8.55 lbs. per sq. in.	95°
Gasoline	7.75 lbs. per sq. in.	100°
Ethyl Alcohol	0.850 lbs. per sq. in.	173°
Water	0.339 lbs. per sq. in.	212°
Turpentine	0.00773 lbs. per sq. in.	300°
Mercury	0.0000251 lbs. per sq. in.	674°

Rate of Diffusion - "The rate of diffusion is the rate of dispersion of gas as compared to air" (air = 1.0)

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 2 in the Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP

REVIEW Assignment Sheet No. 2, re–teach any portion of lesson not thoroughly understood.

TEACHING GUIDE # 3

CLASSIFICATION AND USES OF FIRE EXTINGUISHERS

OBJECTIVES:

1. To become familiar with the various types, uses, operation, and maintenance of first aid fire fighting appliances.
2. To understand the classification of fire extinguishers and its relation with the classification of fires.
3. To be aware of the necessity for using the proper type and size of fire extinguisher on various classes of fire for effective extinguishment.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Fire extinguisher flip charts from manufacturers
3. Various types of fire extinguishers

REFERENCE:

Fire Service Training (text), Chapter III, pp. 26-42.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

First aid fighting appliances are essentially portable first aid devices used to extinguish fire. However, the extinguishers are designed to cope with fires in their infancy and are not intended to act as a substitute for automatic sprinklers, standpipe and hose, or fire department hose streams.

The ease of handling extinguishers, the ability to provide the necessary extinguishing agent to put out the fire quickly and efficiently, the fact that the extinguishers are ready for use when needed, make them a necessary part of fire fighting operations.

Various types of first aid fire extinguishers will be discussed. Each type is of value, but all are not equally effective upon all classes of fire. Therefore, consideration must be given to the class of fire involved, and the proper type of extinguisher to be used. As fires are classified, fire extinguishers are also classified, this is in accordance with their ability to extinguish the particular material or substance on fire.

Because extinguishers must be ready for use at all times, diligence

Instructor's Notes

must be exercised in their care and maintenance in order to assure proper operation at the scene of the emergency.

STEP II - PRESENTING THE LESSON:

A. CLASSIFICATION OF FIRES

For all practical purposes, there are three general classes of fires

1. Class A Fires

   DEFINE - "Class A fires are fires in ordinary combustible materials such as wood, cloth, and paper where the "quenching-cooling" effect of quantities of water or solutions containing large percentages of water is most effective in reducing the temperature of the burning material below the ignition temperature"

2. Class B Fires

   DEFINE - "Class B fires are fires in flammable petroleum products or other flammable liquids, greases, etc., where the 'blanketing-smothering' effect of oxygen-excluding media is most effective"

3. Class C Fires

   DEFINE - "Class C fires are those involving electrical equipment where the electrical non-conductivity of the extinguishing media is of first importance"

B. CLASSIFICATION OF FIRE EXTINGUISHERS

1. Fire extinguisher classifications are based upon the classifications of fire and the fire extinguishment potential as determined by physical testing by the Underwriters' Laboratories, Inc.

   a. The classification consists of a NUMERAL and a LETTER which appears on the label of all appliances APPROVED by the Underwriters' Laboratories

      ***EXPLAIN** the meaning of the **NUMERAL** in terms of the approximate fire extinguishing potential for -*

      (1) Class A extinguishers

      4-A appliance should extinguish twice as much fire as a 2-A appliance

      (2) Class B extinguisher

      The NUMERAL is an approximate indication of the square foot area of a deep-layer flammable liquid fire which can be extinguished. A 10-B unit should extinguish 10 square feet of fire

      (3) Class C extinguisher

      In this class, no NUMERAL is used, since these fires are essentially either Class A or B, which

Instructor's Notes

involve electrical wiring or equipment. The size is determined by the size and area involved, keeping in mind the electrical hazard which must be covered or blanketed by a Class C media for extinguishment

***EXPLAIN** the meaning of the **LETTER** in terms of approval for effective fire extinguishment.*

(1) The letter denotes or indicates the particular class of fire for which the extinguisher is approved for use, in terms of Class "A" - Class "B" - and Class "C" fires

***EXPLAIN** the meaning of **LETTERS** and **NUMERALS** in combination.*

(1) When an extinguisher is labeled - 2A, 4B, it should extinguish approximately twice as much Class "A" fire as a 1-A appliance, and four times as much Class "B" fire as a 1-B appliance. It should also extinguish a flammable liquid fire having a surface area of four square feet

(2) When an extinguisher is rated 6-B, C it should extinguish six times as much Class "B" fire as a 1-B unit. It should also extinguish a flammable liquid fire having a surface area of six square feet

(3) The letter C indicates it is safe to use on fires involving electrical equipment

Refer class to Figure 1 on page 27 (classification table), pick out several units at random, and have class explain NUMERAL and LETTER reference

C. CONVERSION OF EXTINGUISHER CLASSIFICATIONS

***EXPLAIN** - classification conversion table. Refer class to conversion table, Figure 1, Page 27. Select units at random and **DISCUSS**.*

1. In general, old units such as a 2-1/2 gal. Soda-Acid, a 2-1/2 gal. Water, a 15# CO_2 or a 15# Dry Chemical, had a rating of A-1, B-1, or C-1
2. Units with less content would be rated A-2, B-2 or C-2
   a. This means that two of the latter are required to do the job of one of the former
3. For approximate conversions of all older units, the table should be consulted

Instructor's Notes

D. TYPES AND USES OF FIRE EXTINGUISHERS

1. Discussion of first aid appliances will be limited to those generally in use in fire fighting operations
2. Regardless of those which are used, the following items are important:
   - a. They must carry the U. L. Seal of Approval for guarantee of capability and performance
   - b. Instructions regarding maintenance must be followed
   - c. Extinguishers must always be fully charged and ready for operation
3. Water Extinguishers

   Have extinguisher available for dismantling to show class component parts.

   - a. Effective on Class A fires where the quenching and cooling effect of water is necessary, i.e. ordinary combustible materials such as wood, paper, textiles, rubbish, etc.
   - b. Can be used on small fires on combustible floors soaked with oils or greases
   - c. Not effective on Class B fires involving flammable liquids or greases in vats, tanks, or open vessels
   - d. Not recommended on Class C fires, involving electrical equipment
   - e. To operate:
     - (1) Manual or pump type - Push and pull of handle operates piston which forces water through hose
     - (2) Cartridge Type - Invert extinguisher and bump cap on floor. This action causes cartridge to be pierced by cap, which releases carbon dioxide gas and expels the liquid
     - (3) Stored Pressure Type - Pull out safety lock pin in handle or lever, to release the liquid under air pressure of about 125 pounds stored in the container
   - f. Most effective at close range, can be used up to 30' distance
   - g. Force, range, and duration of stream when cartridge or stored pressure operated, are not dependent on operator
     - (1) The 2-1/2 gallon size discharges an effective stream of liquid for approximately one minute
   - h. When subjected to freezing temperatures it should be filled with anti-freeze solution:
     - (1) Calcium chloride and water
     - (2) Mixed thoroughly in proper proportion

   REFER learners to Figure 2, p. 29, Fire Service Training (text).

Instructor's Notes

(3) Common salt should not be used as it may cause corrosion and affect use

i. Shall be kept full at all times
   (1) Do not over-fill (indicate filling mark)

j. Should be recharged immediately after use, observing the following recommendations:
   (1) Wash parts thoroughly with water
   (2) Flush water through hose
   (3) Flush pressure relief hole in cap
   (4) Check gasket
   (5) Weigh cartridge to check charge

k. Extinguishers should be checked and examined at regular intervals for:
   (1) Deterioration
   (2) Damage
   (3) Clogged orifices
   (4) Condition of hose
   (5) Condition of gaskets
   (6) Proper water level
   (7) When pump operated - check operation and lubricate piston rod and packing
   (8) Cartridges, in cartridge operated extinguishers, should be weighed at least every six months to assure proper operating content
      (a) If loss of 1/2 ounce or more is indicated, replace with new one
   (9) In stored pressure type - check pressure gauge for proper operable range

4. Soda - Acid Extinguishers

Have extinguisher available for dismantling to SHOW class component parts.

a. Effective on Class A fires where the quenching and cooling effect of water is necessary, i.e. - ordinary combustible materials such as wood, paper, textiles, rubbish, etc.

b. Can be used on small fires on combustible floors soaked with oils or greases

c. Not effective on Class B fires involving flammable liquids or greases in vats, tanks, or open vessels

d. Not recommended on Class C fires involving electrical equipment

e. Chemicals used to create expelling action are bicarbonate of soda and sulfuric acid.
   (1) In the 2-1/2 gallon size
      (a) 1-1/2 pounds of soda are dissolved in 2-1/2 gallons of lukewarm water and placed in the shell to level of indicator

Instructor's Notes

(b) 4 ounces of commercially pure (CP) sulphuric acid are placed in the acid bottle to level of indicator

f. To operate: in

(1) Invert extinguisher which causes chemicals to mix

(a) Carbon dioxide gas is created which exerts a pressure of about 125 P.S.I. within the tank and expels the liquid

(b) The action of the gas is not a factor in extinguishment, the principal agent being water

g. Force, range, and duration of stream not dependent on operator

(1) Most effective at close range, up to 30' distance

(2) The 2-1/2 gallon size discharges an effective stream of liquid for approximately one minute

h. Store to protect against freezing

(1) Common salt or calcium chloride must not be used as these may cause corrosion and effect the operation

i. Wetting agents should not be added to contents, as foaming action would reduce the effectiveness of the discharge

j. Shall be kept full at all times

k. Should be recharged immediately after use, observing the following recommendations:

(1) Wash all parts with water

(2) Flush water through hose

(3) Flush pressure relief hole in cap

(4) Check gasket

l. Extinguishers should be checked and examined at regular intervals for:

(1) Deterioration

(2) Damage

(3) Clogged orifices

(4) Condition of hose

(5) Condition of gaskets

(6) Proper water level

m. Extinguishers or parts not in good condition should be replaced

n. Acid bottles, stopples, and cages when replaced should be duplicates of originals, so as not to impair operation

o. If not used, extinguishers should be emptied and recharged annually

5. Foam Extinguishers

Have model available for dismantling to SHOW class component parts.

Instructor's Notes

a. Effective on fires in small quantities of flammable liquids, greases, etc., in vats, tanks, open vessels, on floors or surfaces or any other Class B fires where the foam will form a blanket on the burning material

b. Unless specifically indicated on the name plate, they are not to be used on fires involving alcohol, ether, acetone, lacquer thinner or carbon disulfide
   (1) Because without the proper additive, the foam bubbles are broken down making the smothering action ineffective

c. Can be used on incipient fires of Class A materials, as 85% of the weight of the extinguishing agent is primarily water

d. Is not recommended on Class C fires involving electrical equipment

e. Chemicals used to create expelling action and foam blanket are:
   (1) Bicarbonate of soda,
   (2) A foam stabilizing agent
   (3) Aluminum sulphate
   (4) The chemicals are packaged A and B, and directions by manufacturer are explicit and are to be followed in charging
      (a) The A package containing the aluminum sulphate is dissolved in 2-1/4 pints of water and placed in the inner chamber.
      SHOW inner chamber.
      (b) The B package containing the bicarbonate of soda and foam stabilizer is dissolved in 7 quarts of water and placed in the outer chamber
      SHOW outer chamber.
      The stabilizer may be an extract of licorice, saponin or chicle. Its purpose is to form and make the bubbles smaller and more tenacious. The bubbles contain the carbon dioxide gas which forms the blanket that excludes the oxygen and smothers the fire.

f. To operate:
   (1) Invert extinguisher which causes chemicals to mix
      (a) Carbon dioxide gas is created which exerts a pressure of about 100 P.S.I within the tank and expels the foam extinguishing agent

Instructor's Notes

(2) The stream of foam is most effective when directed from a distance against the opposite inside wall of the vessel involved, just above the burning surface
  (a) This permits the foam to spread back over the burning liquid
  (b) The stream should NOT be directed INTO the burning liquid
  (c) Where possible the operator should walk around the fire while directing the streams

(3) Force, range and duration of stream is not dependent on operator
  (a) Can be used from a distance of 30 feet effectively, or at closer range if necessary
  (b) The 2-1/2 gallon size discharges an effective stream of foam for approximately one minute, or about 20 gallons of foam if properly charged

g. Store to protect against freezing
  (1) Common salt or calcium chloride must not be used as they may cause corrosion and effect the operation

h. Shall be kept full at all times

i. Should be recharged immediately after use, observing the following recommendations:
  (1) Wash all parts with water
  (2) Flush water through hose
  (3) Flush pressure relief hole in cap
  (4) Check gaskets

j. Should be checked and examined at regular intervals for:
  (1) Deterioration
  (2) Damage
  (3) Clogged orifices
  (4) Condition of hose
  (5) Condition of gaskets
  (6) Proper filling level

k. Extinguisher or parts not in good condition should be replaced

l. Only charges supplied by manufacturer should be used
  (1) Chemicals must be mixed, stirred and disolved in exact accordance with instructions indicated

m. If not used, extinguishers should be emptied and recharged annually

6. Vaporizing Liquid Extinguishers

Have extinguisher available and SHOW to class.

Instructor's Notes

a. Effective on fires in small quanities of flammable liquids, greases, etc., in vats, tanks, open vessels, on floors or surfaces, or any other Class B fires where gas formed by vaporization of the liquid may be retained as a blanket on the burning material

b. Effective on fires in electrical equipment or other Class C fires where a non-conducting agent is important

c. Effective on automobile fires involving the motor or wiring

d. Somewhat effective on small surface fires where the smothering effect of the gas may be utilized

e. Not effective on deep seated Class A fires requiring a quenching and cooling effect for extinguishment

f. Chemicals used are carbon tetrachloride and chlorobromomethane
  (1) They have very low freezing points
  (2) Commercial Carbon Tetrachloride freezes at -8° F to -10° F
    (a) But, ingredients are added which lower the freezing point to -50° F, and also control corrosion
  (3) Chlorobromomethane has a freezing point of -124° F for rapid decomposition when in contact with flame or hot surfaces
  (4) Studies have indicated that gases liberated both before and after decomposition are very toxic
  (5) In the presence of flame or hot surfaces, carbon tetrachloride may decompose forming hydrochloric acid, phosgene, and free chlorine
  (6) Chlorobromomethane produces traces of hydrochloric acid, phosgene, bromophosgene, free bromine and chlorine
  (7) Both gases are about 5 times heavier than air
    (a) Which accounts for the smothering action they effect in fire extinguishment

g. Precautions should be taken to avoid breathing the gases or vapors from these liquids
  (1) Especially when working in unventilated spaces

h. Gas masks are recommended when using these extinguishers

i. To operate:
  (1) Extinguishers are either hand operated or stored-pressure types
  (2) The stream is usually most effective when used at close range

Instructor's Notes

(a) A distance of 20 to 30 feet

(3) The stream should be directed into the burning part on electrical fires

(4) On flammable liquid fires, the stream should be directed against the inside wall of the container, just above the burning surface so as to break up the stream

(a) Operator should walk around the fire while directing stream

(b) The stream should NOT be directed into the burning liquid

(5) Force, length, and duration of stream are dependent on operator

(6) The 1-1/2 quart size will be completely discharged in about 3/4 of a minute under normal operation

j. Needs no protection against freezing

k. Shall be kept full at all times

l. Should be recharged immediately after use, observing the following precautions:

(1) Liquid other than that furnished by the manufacturer should not be used, because it may effect operation

(2) Water should NOT be used in these extinguishers

m. Should be checked and examined at regular intervals for:

(1) Damage

(2) Corrosion (very important)

(3) Clogged orifices

(4) Manually operated pump type units should be tested by discharging portion of liquid with the stream directed alternately upward and downard to check internal discharge tubes

(5) Proper filling level

(6) Pressure gauge should be checked on pressurized type

7. Carbon Dioxide Extinguishers

Have extinguisher available and SHOW to class.

a. Effective on fires in small quantities of flammable liquids, greases, etc., or any other Class B fire

(1) Where smothering action is required to extinguish the flame

b. Effective on fires in electrical equipment or other Class C fires

(1) Where a non-conducting agent is important

c. Effective on fires in automobiles, boats, etc.

Instructor's Notes

d. Somewhat effective on small surface fires
  (1) Where smothering effect of the gas may be utilized
e. Not effective on deep seated Class A fires
  (1) Requiring a quenching cooling effect for extinguishment
f. Chemical used is liquid carbon dioxide under pressure of 800 to 900 P.S.I. at normal temperature
  (1) Pressure will vary at different temperatures
    DISCUSS chart, Figure 19, p. 36, Fire Service Training (text).
  (2) The gas is inert and does not support combustion
  (3) The expansion of the liquid into a gas as it is released chills it to approximately - 110^{o} F
    (a) However, this low temperature is negligible in terms of extinguishment
  (4) One pound of liquid carbon dioxide converted to gas at room temperature will occupy approximately 8.6 cubic feet
  (5) At ordinary room temperature and atmospheric pressure, carbon dioxide is one and one-half times heavier than air
  (6) Carbon dioxide gas may cause suffocation due to oxygen deficiency
    (a) When used in confined areas, firemen should take precautions to avoid breathing heavy concentrations for extended periods of time

g. To operate:
  (1) Pull out safety lock pin, and squeeze trigger or grip on handle
  (2) The force, range, and duration of discharge are independent of the operator when the valve is open
    (a) The 20 and 25 pound size have an effective range of 6 to 8 feet, and will discharge in about one minute
  (3) Extinguisher, while being operated, must remain in upright position
    (a) To prevent possibility of liquid entering expelling tube
  (4) When directing discharge, keep it away from the eyes
  (5) Before approaching fire, test workability by briefly squeezing grip
  (6) On flammable liquid fires, the discharge should be used to sweep the flame from the burning surface

Instructor's Notes

- (a) By applying first at the near edge of the fire
- (b) Gradually progressing forward
- (c) While moving discharge slowly from side to side
- (d) Whenever possible, have wind at back
- (e) Be careful of potential reflash

h. Shall be kept full at all times
- (1) Check by weighing

i. Needs no protection against freezing

j. Shall be recharged immediately after use, even though only partially discharged
- (1) Recharging should be done only by:
  - (a) Manufacturer
  - (b) Authorized agent
  - (c) Producer of carbon dioxide
  - (d) Local recharging facilities if available

k. Shall be checked and examined at regular intervals for:
- (1) Damage
- (2) Deterioration
- (3) Leakage
  - (a) When loss of weight over 10% of rated capacity is indicated, it should be recharged

l. Extinguisher and parts in poor condition and not operating properly should be replaced, or returned to manufacturer

8. Loaded Stream Extinguishers

Have extinguisher available for dismantling to SHOW class component parts.

a. Effective on Class A fires where the quenching and cooling effect of water is necessary

b. Somewhat effective on small fires of flammable liquids, greases, or other Class B fires

c. Not recommended on Class C fires

d. Chemical used is a solution of alkali - metal - salt having a freezing point of -40° F
- (1) Produces a chemical reaction tending to inhibit or restrain oxidation by coating the material on fire
- (2) This acts as a fireproofing agent to prevent rekindling

e. To operate:
- (1) Cartridge Type
  - (a) Invert extinguisher and bump cap on floor. This action causes cartridge to be pierced by pin in cap which releases carbon dioxide gas and expels liquid

Instructor's Notes

(2) Stored Pressure Type
  (a) Pull out safety lock pin in handle and squeeze handle or lever to release the liquid under air pressure of about 125 pounds stored in the container
(3) As a rule the stream should be directed at the base of flame
(4) On flammable liquid fires:
  (a) The discharge should be directed against the inside wall of the container, just above the burning surface
  (b) The stream should NOT be directed into the burning liquid
  (c) Where possible, operator should walk around fire while directing stream for maximum coverage

f. Force, range, and duration of stream from:
  (1) Cartridge type not dependent on operator
  (2) Stored pressure type may be dependent on operator
  (3) Effective range is approximately 30 to 50 feet
  (4) The 2-1/2 gallon size will discharge an effective stream for about one minute

g. Needs no protection against freezing

h. Shall be kept full at all times

i. Should be recharged immediately after use, observing the following recommendations:
  (1) Wash all parts with water
  (2) Flush water through hose
  (3) Flush pressure relief hole in cap
  (4) Check gaskets
  (5) Weigh cartridge for leakage

j. Extinguishers should be checked and examined at regular intervals for:
  (1) Deterioration
  (2) Damage
  (3) Clogged orifices
  (4) Condition of hose
  (5) Condition of gaskets
  (6) Proper liquid level
  (7) Cartridge weight
    (a) If loss of 1/2 ounce or more is indicated, replace with new cartridge
  (8) When stored-pressure operated, check pressure gauge for proper operable range at 125 pounds

Instructor's Notes

(9) Only chemicals and cartridges furnished by manufacturers should be used

k. Cartridges should be removed and weighed every six months to assure proper operating content

l. Extinguisher or parts not in good condition should be replaced or returned to manufacturer for examination and repair

9. Dry Chemical Extinguishers

Have extinguisher available for dismantling to SHOW class component parts.

a. Effective on Class B fires

b. Effective on Class C fires

c. Effective on fires in automobiles, boats, etc.

d. Somewhat effective on small quantities of material where the smothering effect may be effective

e. Not effective on deep seated Class A fires

f. Chemical used, is sodium bicarbonate

- (1) Specially treated for producing free flow and water repellency
  - (a) The latter provides a coating on surfaces, inerting the material, preventing rekindling and retarding progress of fire

g. To operate stored-pressure type

- (1) Pull out safety lock pin and squeeze trigger or handle

h. To operate cartridge operated type

- (1) The handle is pushed down, puncturing a sealed disc in the cartridge
- (2) In both types, the pressure exerted expels the dry chemical from the container
- (3) On the cartridge type the discharge is controlled by a shut-off nozzle at the end of the hose
- (4) The unit must remain in an upright position when in use to prevent contents from being expelled improperly
- (5) To check workability, the handle or grip should be squeezed briefly before approaching fire
- (6) For best results, direct discharge at near edge of of fire,
  - (a) Progress forward,
  - (b) Moving nozzle rapidly with a side to side sweeping motion
- (7) If possible have wind at back
- (8) On surface fires involving Class A materials, the discharge should be directed about 3 to 4 feet above the flame to allow proper settling action

Instructor's Notes

for coating material

(9) On flammable liquid fires, where high velocity nozzles are indicated on name plate, care should be taken to direct discharge from a distance of not less than 6 to 8 feet
    (a) To prevent splashing of liquid

i. The force, range, and duration of discharge is dependent on operator's control of shut-off
    (1) An effective continuous discharge with the nozzle open is obtained for approximately one minute at a distance of 10 to 20 feet

j. Needs no protection against freezing

k. Powder in shell should be stirred frequently to keep from packing

l. Should be kept full at all times

m. Should be recharged immediately after use, even when partially discharged, observing the following precautions:
    (1) Chemicals other than those furnished by manufacturer, should not be used
    (2) Follow manufacturer's re-charging instructions
    (3) Use moisture trap when recharging pressurized units

n. Should be checked and examined at regular intervals for:
    (1) Deterioration
    (2) Damage
    (3) Clogged orifices
    (4) Condition of hose
    (5) Condition of gaskets
    (6) Proper operating pressure indicated on gauge
    (7) Weight of cartridge
        (a) If loss is over 10% of rated capacity, replace
    (8) Extinguisher or parts not in good condition should be replaced or returned to manufacturer for examination and repair

10. A, B, and C Dry Chemical Extinguishers

Have extinguisher available to SHOW class.

a. Approved effective for all classes of fires

b. Chemical action of powder upon contact with fire involving:
    (1) Class A - Deposit formed by powder acts as insulation, and prevents rekindling
        (a) Change from powder to deposit absorbs heat and effects cooling

Instructor's Notes

- (2) Class B - Smothering and cooling
- (3) Class C - Non-conductor of electricity
- (4) Magnesium (combustible metal) - Smothers, insulates, and cools

c. Chemical is non-toxic, non-poisonous, and non-abrasive

d. Needs no protection against freezing
- (1) Operable at -40° F

e. To operate stored-pressure type
- (1) Pull out safety lock pin and squeeze trigger or handle
  - (a) Internal pressure expells powder from nozzle

f. To operate cartridge type
- (1) Pushing down on handle, puntures sealed disc on cartridge
  - (a) Realeasing gas into cylinder, expelling powder

g. The unit must remain in an upright position when in use to prevent contents from being expelled improperly

h. To check workability, the handle or grip should be squeezed briefly before approaching fire

i. For best results, direct discharge at near edge of fire and progress forward, moving nozzle rapidly with a side to side sweeping motion

j. If possible have wind at back

k. On surface fires involving Class A materials, the discharge should be directed above flame to allow proper settling action for coating material

l. The force, range, and duration of discharge is dependent on operator's control of shut-off
- (1) An effective continuous discharge from the 20 and 30 pound units with the nozzle open is obtained for approximately ten to fifteen seconds at a distance of twelve to fifteen feet

m. Should be kept full at all times

n. Should be recharged immediately after use, even when partially discharged, observing the following precautions:
- (1) Chemicals other than those furnished by manufacturer, should not be used
- (2) Follow manufacturer's re-charging instructions

o. Should be checked and examined at regular intervals for:
- (1) Deterioration

Instructor's Notes

(2) Damage
(3) Clogged orifices
(4) Condition of hose
(5) Condition of gaskets
(6) Proper operating pressure indicated on gauge
(7) Weight of cartridge
    (a) If loss is over 10% of rated capacity, replace
(8) Extinguisher or parts not in good condition should be replaced, or returned to manufacturer for examination and repair

E. GENERAL INFORMATION

Summarize briefly some of the more important factors that relate to the use, maintenance, and operation of all types of extinguishers, they are as follows:

1. Hydrostatic pressure test every five (5) years to assure safe operation
2. Use and maintenance of department records for each extinguisher
    a. Date of purchase
    b. Date used
    c. Date inspected
    d. Date recharged
    e. Date of repairs and replacement
3. Understand when, where, and how each extinguisher should be used, especially when dealing with electrical equipment
4. Enforce checking and examination procedure at regular intervals for all extinguishers
5. Always remember, extinguishers are only first aid appliances, and their limitations must be recognized
6. The size and type of extinguisher must be recognized in accordance with the size and type of fire involved
7. The manufacturer's instructions should always be adherred to in the maintenance and operation of each extinguisher
8. Storage areas for extinguishers should be selected carefully
    a. Rooms subjected to freezing temperatures, or temperatures in excess of 120° F should not be used
9. Care must always be exercised in the operation of different types of extinguishers on the same fire
    a. If the contents are incompatible, the action of one type will be offset by the action of the other, and disasterous results may be obtained

nstructor's Notes

10. Tightness and condition of threads must be checked
11. It is advisable to completely compress extinguisher handle when putting in use

F. TYPES, SIZES AND USES OF FIRE EXTINGUISHERS

Refer class to chart on Types, Sizes, and Uses of Fire Extinguishers-Figure 30, p. 42, Fire Service Training (text). DISCUSS and/or EXPLAIN the various units listed thereon.

STEP III - APPLICATION

Have learners work Assignment Sheet No. 3 in the Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP

REVIEW Assignment Sheet No. 3, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #4

WATER AS USED IN FIRE FIGHTING

OBJECTIVES:

1. To present to the fireman facts about heat absorption and physical properties of water and how it can best be used to extinguish fires.
2. To acquaint the fireman with the types and uses of fire streams.
3. To teach the principles and the importance of "hydraulics" in the fire service.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Models, mockups, and charts

REFERENCE:

Fire Service Training (text), Chapter 4, pp. 43-69.

Instructor's Notes STEP I - INTRODUCING THE LESSON:

Water is the most widely used extinguishing agent due to its high heat absorption capacity. Regardless of the source of water supply the local fire department must be equipped to transport this water through suction hose, pumps, fire hose and nozzles to the place where the water can best be used to extinguish the fire.

All firemen should know the loss that can occur when water is used improperly to extinguish a fire. Most of all, they must know its extinguishing powers and the amounts available in each community.

Successful fire fighting depends upon an adequate fire stream. One individual type of fire stream, at a common pressure, will not always meet the demand, consequently, there are different types of fire streams used to meet different conditions. Water must be applied properly to achieve the highest extinguishing effect with the least amount of water damage. Therefore, it is of utmost importance for firemen to know how to use modern fire fighting equipment in order to obtain the most efficient fire streams.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. HEAT ABSORPTION OF WATER

1. **EXPLAIN how water absorbs the heat from a fire**
2. **EXPLAIN how steam, that is formed by the application of water on a fire, assists in extinguishing a fire**
3. **EXPLAIN ignition temperature**

REFER learners to Figs. 1, 2, 3 and 4, pp. 44-45, Fire Service Training (text). EXPLAIN and DISCUSS by placing on chalkboard.

B. THE PHYSICAL PROPERTIES OF WATER

DISCUSS the general physical properties of water and safety precautions involved.

1. **The vertical pressure of a liquid is proportional to the height alone, and is not influenced by the size or shape of the container**
2. **There are 1,728 cubic inches in one cubic foot**
3. **There are 231 cubic inches in one gallon**
4. **There are 7.5 gallons of water in one cubic foot**
5. **One cubic foot of water weighs 62.5 pounds**
6. **One gallon of water weighs 8.35 pounds**
7. **Pressure is a measurement of energy referred to in pounds per square inch, (p.s.i.)**
8. **A column of water one foot high and one inch square exerts a pressure of .434 p.s.i. on its base**

PLACE following example on chalkboard.

Height x .434 -- p.s.i. on its base
1" x .434 -- .434 p.s.i. on its base

9. **A column of water 2.31 feet high exerts a pressure of 1 p.s.i. on its base**

PLACE example on chalkboard.

Heights x .434 = p.s.i. on its base
2.31 x .434 = 1.00 p.s.i. on its base

10. **"Static pressure is the pounds pressure per square inch exerted by a body of water at rest, either horizontally or vertically"**
11. **"Back pressure is the pounds pressure per square inch created by a column of water on its base"**

SEE examples under 8 and 9.

12. **The area of a square or a rectangle is equal to its length times its width**

PLACE example on chalkboard.

Instructor's Notes

Example: Using a 4' x 6' rectangle

Area = L x W
4' x 6' = 24 sq. ft.

13. The area of a circle equals diamater squared times .7854
PLACE example on chalkboard.
Example: Using a 4' diameter

Area = D x D x .7854
4' x 4' x .7854
16' x .7854 = 12.56 sq. ft.

14. The volume of a cylinder equals the area of its base times the height of the cylinder
PLACE example on chalkboard.
Example: Using a 12' tank having a 4' diameter

Volume = Area of base x height
(D x D x .7854) x H
(4 x 4 x .7854) x 12
(16 x .7854) x 12
12.56 x 12 = 150.72 cubic ft.

15. For all practical purposes, it must be understood that water cannot be compressed
    a. Since water remains at a constant volume, a given weight of water will occupy the same amount of space at all times regardless of the shape of its container

16. The hose size, its gallon content, and the weight of the water in each section of hose is indicated in Figure 5, p. 46, Fire Service Training (text)
    a. A 50 foot section of dry 2-1/2" double jacket nylon or dacron hose having forged couplings weighs approximately 38 pounds.
        (1) Add to these figures the weight of the water within the hose to obtain the approximate total weight of the hose and water
        (2) This item must be considered when hose is elevated up the side of a building or ladder
        (3) This emphasizes the need for a supporting means
            (a) Such as a rope hose tool or hose strap, to relieve some of the weight from the hose couplings in the elevated hose line

Instructor's Notes

C. WATER FROM DRAFT

DISCUSS the following theories of drafting water.

1. Suction Lift
   REFER learners to Fig. 7, p. 47, Fire Service Training (text).
2. Pressure Lift
   REFER learners to Fig. 8, p. 47, Fire Service Training (text).
3. EXPLAIN maximum feet of lift possible under various conditions
   REFER learners to Fig. 9, p. 48, Fire Service Training (text).

D. WATER SUPPLY FROM HEAD PRESSURE

DEFINE - "Head pressure is the term used to describe the operation of supplying water to a pumping unit when such units are connected to a fire hydrant or when connected in relay with one or more pumpers"

1. EXPLAIN the value of hydrant having low flow pressures and a large volume of water available vs. one having a high intake pressure and a small volume of water available
   EXAMPLE - A sixteen inch water main at 30 lbs. pressure will yield more volume than a six inch main at 80 lbs. pressure
2. EXPLAIN the limitations of a positive displacement type pump vs. a centrifugal

REFER to Teaching Guide No. 7 on Fire Pumps in this manual for explanation.

E. TYPES OF FIRE STREAMS

BUILD UP the following chart on the chalkboard or pad and DISCUSS.

TYPES OF FIRE STREAMS

Solid Streams
Spray (vapor) or Fog Streams
Master Streams
   a. Deck nozzles
   b. Ladder pipes

Broken Streams
Water Curtains
   a. Permanent installation
   b. Formed by use of hose streams

F. USES OF TYPES OF FIRE STREAMS

1. "Solid Stream - is a stream where impact and range are essential"
   a. Manually operated hand line
      REFER learners to Fig. 10, p. 49, Fire Service Training (text).
   b. Master stream of greater capacity than those that can be controlled manually (appliances)
      REFER learners to Figs. 18-19, p. 51, Fire Service Training (text).
   c. Penetration and deflection
      REFER learners to Figs 11 thru 17, pp. 49-51, Fire Service Training (text) and DISCUSS.

Instructor's Notes

2. "Broken Stream - is one which discharges water from a nozzle in the form of a solid stream, then it is broken up by means of an outside force, such as a wall, partition, ceiling, or material, and etc"
    - a. Mechanical means of producing broken streams
        - (1) Distribution or rotary nozzle

          REFER learners to Fig. 20, p. 52, Fire Service Training (text).
        - (2) Partition nozzle

          REFER learners to Fig. 21, p. 52, Fire Service Training (text).
        - (3) Sprinkler heads
    - b. Uses of broken streams
        - (1) Basement fires
        - (2) For cooling effect
        - (3) On or around electrical equipment
        - (4) Chemical fires
        - (5) In overhauling
3. "Spray (vapor) and Fog Streams - a stream having many jets of water being discharged through a specially designed nozzle"
    - a. Types of spray and fog streams

      REFER learners to Fig. 22, p. 53, Fire Service Training (text) for types of nozzles.
    - b. Uses of spray and fog streams
        - (1) On confined fires
        - (2) On flammable liquid fires
        - (3) On chemical fires
    - c. A much higher pump pressure must be maintained for an effective vapor stream than for an effective solid or broken stream
4. "Water Curtain - is a sheet of water used to protect a building close to one that is involved in fire by breaking down the heat waves"
    - a. Isolates the fire to its point of origin, whether it be an inside or outside exposure

      REFER learners to Figs. 23 thru 26, pp. 54-55, Fire Service Training (text).
5. "Master Streams - are either solid or fog streams of greater capacity than those that can be controlled manually"
    - a. Controlled by appliances

G. FACTORS NECESSARY TO PRODUCE FIRE STREAMS

1. Adequate water supply under pressure
2. Sufficient hose line
3. Proper type and size of nozzle

Instructor's Notes

H. CAUSES OF DEFECTIVE STREAMS

***DEVELOP** following list on chalkboard, **DISCUSSING** each point as developed.*

CAUSES OF DEFECTIVE STREAMS

Insufficient Nozzle Pressure
Too much pressure
Nozzle burr
Bend in hose near the nozzle
Winds of large proportions
Various types of obstructions
Defective shut-off nozzle
Protruding gasket within the hose and nozzle
Misinformed and untrained personnel
Any other cause suggested by the group

I. HYDRAULICS

It is not the intent of this Basic Course to make pump operators out of each fireman, but to teach the fundamental principles of fire department hydraulics.

The information presented in this section was prepared with the full knowledge that there are several approved, practical methods used by firemen to arrive at approximate answers for problems in fire department hydraulics.

1. **Successful fire fighting depends upon adequate fire streams properly applied**
2. **The prime purpose of hydraulics is to supply water when it is needed and requested**
3. **Pump operators should have a complete understanding of fire department hydraulics, in addition to having a good working knowledge of the pump**
4. **Terminology Relating to Hydraulics**
   ***LIST** on chalkboard and **DEFINE** the following:*

TERMINOLOGY

g.p.m.
p.s.i.
FL
PP
NP
EL
ft.

+
-
÷
X
Story
Floor
Street 40'

Sidewalk 13'
Back pressure
Hydrant pressure
Static pressure
Residual pressure
Pull-back pressure

5. **EXPLAIN pull-back pressure for various size tips**
   ***REFER** learners to chart on p. 57, Fire Service Training (text).*

Instructor's Notes

6. "Friction Loss - is the resistance encountered by the free flow of water in fire hose, nozzles, nozzle tips and appliances"
   - a. EXPLAIN and DISCUSS the following friction loss problems and/or charts

     REFER learners to the appropriate problem and figure, pp. 57 thru 61 Fire Service Training (text), for the following items (1) thru (4).

     - (1) Figuring friction loss in one 100' line, paragraph #1, page 58, Figure 28, page 57
     - (2) Figuring friction loss when lines are added, paragraph #2 and #3, and Figure 29, page 58
     - (3) Friction loss with different size nozzle tips, paragraph #4, page 58, Figure 30, page 59
     - (4) Considerations in hose layouts, paragraph #5, page 58, Figure 31, page 59
   - b. Combating friction loss
     - (1) Reduce the nozzle pressure
     - (2) Reduce the tip size and maintain the same nozzle pressure
     - (3) Siamese the hose lines

       REFER learners to appropriate figures in Fire Service Training (text), for (a) and (b) following:

       - (a) Comparison of single and siamese lines, Fig. 32, p. 60
       - (b) Single and siamese lines into deluge nozzle, Fig. 33, p. 60
   - c. Friction loss in 1-1/2" hose

     REFER learners to the following two examples in Fire Service Training (text).

     - (1) Example #1, col. 1, p. 61
     - (2) Example #2, col. 1, p. 61

8. Determining G.P. M. Discharged
   - a. Discuss - Gallons of water flowing per minute at various nozzle pressures and sizes, Figure 37, page 65

     REFER learners to Fig. 37, p. 65, Fire Service Training (text).

9. Determining Required Pump Pressures

   Instructor must determine the amount of coverage to include under this heading for each class in basic training.

   - a. Explain formula PP = NP + FL + EL
   - b. Determining pump pressure in a single line layout

     PLACE following problem from col. 2, p. 62, Fire Service Training (text), on chalkboard and EXPLAIN:

     Problem on single line layout 1-1/8 " tip; 400' of 2-1/2 hose; 50 p.s.i. NP; no elevation

Instructor's Notes

c. Determining pump pressure in a siamese line layout
PLACE following problem from col. 2, p. 62, Fire Service Training (text), on chalkboard and EXPLAIN.

Problem on siamese line layout - 2-1/2" hose; 1-1/8" tip; 400' of 2-1/2" hose in each line joined into one line; 280 g.p.m.; 50 p.s.i. NP. FL per 100' of 2-1/2" hose in a siamese line is approximately one-fourth of that in a single line discharging an equal g.p.m.

(1) Point out the lower pump pressure required in the siamese line layout over the single line layout in the previous two problems

10. Relay of Pumpers
    a. Things to be considered in relay operations
        (1) Length and size of hose between pumpers
        (2) Capacity of pumpers
        (3) Gallons per minute that will be discharged from the pumper closest to the fire
        (4) Friction loss in the hose from one pumper to the next
        (5) Difference in elevation between the pumper and the elevation of the nozzle
11. Fire Hose vs. Suction Hose
    a. One 4-1/2" suction hose connected to a hydrant is capable of flowing three to four times more water than can be supplied through one 2-1/2" fire hose from the same hydrant
12. Foam Equipment
    a. Used to combat Class "B" fires
        (1) Chemical foam equipment
        (2) Mechanical foam equipment
    b. Knowledge of location, construction and operation of fixed foam system installations in area of protection is necessary

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 4 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOWUP:

REVIEW Assignment Sheet No. 4, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #5

FIRE HYDRANTS

OBJECTIVES:

1. To impress upon the learner the importance of having some knowledge of the water supply and distribution system of a community.
2. To acquaint the learner with the characteristics of various types of fire hydrants and their operation.
3. To have the learner understand the importance of flow pressure and volume of water available from each hydrant.
4. To convey to the learner the proper procedure for inspecting and testing fire hydrants.
5. To teach the learner how to conduct fire flow tests on the water distribution system.

TEACHING AIDS:

1. Chalkboard, chalk and eraser; or chart pad
2. Sample water distribution system map
3. Colored chalk to demonstrate coding of hydrants
4. Hydrant model or chart if available

REFERENCE:

Fire Service Training (text), Chapter 5, pp. 70-82.

Instructor's Notes STEP I - INTRODUCING THE LESSON

One of the greatest assets of a community from a fire fighting standpoint is an ample water supply piped through an acceptable distribution system to operable hydrants.

Firemen located in a community having a water supply piped to hydrants should have a thorough knowledge of:

a. The water main sizes and pressures, and the volume of water available to each hydrant
b. The operating characteristics of the hydrant
c. The care and maintenance of hydrants

Members of fire departments that do not have a water supply to hydrants, but do have a mutual aid pact with communities that do have, should also become familiar with their hydrant operation prodedures.

Instructor's Notes

STEP II - PRESENTING THE LESSON

A. CODING HYDRANTS

1. The volume of water available from a fire hydrant is determined by:
    - a. The size of the main supplying the hydrant
    - b. The static pressure at the hydrant
    - c. The size of the lead-in pipe (lateral) from the main to the hydrant. (Should be 5 to 6 inches)
    - d. The size of feeder mains supplying the gridiron system
    - e. The head pressure which is the pressure at the source, whether it be a gravity tank or pump
    - f. Properly gridironed (fed from both ends)

Additional information for the instructor:

An adequate water distribution system will consist of primary feeder mains leaving the source of supply. The mains being large enough to carry ample quantities of water to the smaller mains that branch out and serve the rest of the community.

In larger systems, secondary feeders of intermediate size are used to supply gridiron arrangements of smaller mains serving fire hydrants and blocks of consumers.

A gridiron system means small mains cross connected between larger mains.

Looping is an arrangement whereby secondary feeders, after leaving the primary feeder mains, will circle an area and connect back into the primary feeder. This assures a supply from both directions.

A dead end hydrant is a hydrant located on the end of a main and fed from one direction only.

2. Simple method of coding hydrant, in relation to the size of the main by which they are supplied:
    - a. Select a color code
    - b. Paint the outlet caps a designated color indicating the size of the main
    - c. EXAMPLE of coding:
        - (1) Black - 4 inch or smaller main; also dead end
        - (2) Red - 6 inch main
        - (3) Yellow - 8 to 10 inch main
        - (4) Green - 12 inch or larger main

Instructor's Notes

d. Relate the color of the hydrant cap to the G.P.M. capacity of pumpers:
   (1) Black cap - will seldom supply a 500 G.P.M. pumper (indicates caution)
   (2) Red cap - will supply a 500 G.P.M. pumper and sometimes up to a 1,000 G.P.M. pumper depending upon the distance from the secondary feeder main
   (3) Yellow cap - will normally supply up to a 1,250 G.P.M. pumper
   (4) Green cap - any pumper, sometimes two pumpers
   (5) This rule of the thumb method, may not apply if more than one pumper is operating in the same area
   (6) Volume of water available to groups of hydrants in a certain area may be determined by conducting flow tests

B. HYDRANT PRESSURES

1. Volumes of water in excess of 500 G.P.M. may be required from any hydrant
2. Many water systems in service today contain a considerable amount of 4 inch pipe
3. No pipe less than 6 inches in diameter is recommended for the fire service
4. Friction loss in 4 inch pipe when flowing 500 to 600 G.P.M. is 10 to 15 pounds per hundred feet
5. A dead end 4 inch main, 400 feet long, at a static pressure of 50 pounds would be unable to deliver 500 to 600 G.P.M. to a pumper
6. Hydrants located on mains fed from both ends will deliver more water because of reduced friction loss
   a. Static pressure is pressure in the main when the water is at rest
   b. Flowing pressure is the pressure at the outlet when the hydrant is turned on
   c. Residual pressure is the remaining pressure in the system when a given volume of water is flowing
   d. Friction loss takes place in the water mains the same as it does in hose, only at a greater rate because of the roughness of the pipe interior
   e. EXAMPLE - Friction loss in a 4 inch pipe when flowing 600 G.P.M. is 15 pounds per 100 feet. At 60 pounds pressure in the system, 400 feet would be the maximum distance this volume of water could be

Instructor's Notes

moved in a dead end main. The hydrant taking its supply from both ends, would draw 300 G.P.M. from each direction

- f. Friction loss when moving 300 G.P.M. through 4 inch pipe is 4 pounds per 100 feet. At 60 pounds static pressure, this volume could be moved 1,500 feet from both directions

7. Two pumpers should not operate from a 4 inch main
8. The larger the main, the less the friction loss when moving a given volume of water
   - a. EXAMPLE - 1,000 G.P.M. through 1,000 feet of 4 inch pipe, friction loss equals 370 pounds. The same volume of water through the same length of 6 inch pipe encounters a loss of 52 pounds
9. Firemen should become familiar with private hydrant systems located in industrial plant areas

C. EXPLAIN ITEMS ON HYDRANT RECORD CARD, HYDRANT SERVICE RECORD CARD AND HYDRANT INSPECTION RECORD CARD

***REFER** learners to items 1 through 17, p. 72, and Figures 1, 2, & 3, Fire Service Training (text).*

D. TYPES OF FIRE HYDRANTS

1. General Types
   - a. Two general types - construction wise
     - (1) Break type
       - (a) Standpipe (barrel) and stem are in two sections
       - (b) Joined together a few inches above ground level with a special ring
       - (c) Will withstand ordinary blows
       - (d) Will break cleanly if struck a sharp blow such as by a skidding vehicle. The result will be little or no damage to the valve located below ground

       ***REFER** learners to Figures 4 & 5, p. 74, Fire Service Training (text).*
     - (2) Standard type
       - (a) Constructed in one section
       - (b) Sharp blow will cause serious damage to the entire mechanism

     Many makes are manufactured by various firms. The operating principles are the same but individual features vary, such as drip rods and drainports, etc.
2. Self Draining Hydrants
   - a. Constructed so as to permit the:

Instructor's Notes

  - (1) Water remaining in the barrel after the hydrant is fully closed, to drain out through drainports to the underground drainage area surrounding the hydrant

    REFER learners to Fig. 6, p. 74, Fire Service Training (text).

- b. Surface water
  - (1) Surface water surrounding the hydrant often times is higher than the drainage ports within the hydrant
  - (2) If this situation is continuous, the drainports should be plugged and the hydrant should be pumped out after each use

3. High Pressure Hydrants
   - a. Generally supplied by a special water system
     - (1) Equipped with high pressure pumps
     - (2) Designed to develop high pressure when needed

   REFER learners to Fig. 7, p. 74, Fire Service Training (text).

   - b. Operation of high pressure hydrants (Mathews)
     - (1) Hydrant has four 2-1/2" outlets
     - (2) Each outlet has an individual discharge valve
     - (3) Main operating valve controls water supply into the hydrant. Operating nut is located on the top of the hydrant directly in the center
     - (4) To operate:
       - (a) Close all individual discharge valves
       - (b) Use hydrant wrench and turn main valve counter-clockwise five turns
       - (c) Remove outlet cap and connect hose
       - (d) Open main valve all the way
       - (e) Slowly open the independent valve by turning it counter-clockwise. Operating nut is located on top of the hydrant directly above the outlet
       - (f) Open each outlet valve as needed
     - (5) Closing the hydrant
       - (a) All four outlet valves must be closed first
       - (b) Close main valve by turning operating nut clockwise
     - (6) Draining hydrant
       - (a) After hydrant is completely shut down, remove hose
       - (b) Open one independent valve allowing air to enter barrel
       - (c) Will permit water to drain out through open drain valve

structor's Notes

(d) When water is properly drained, close outlet valve and replace hydrant cap

E. TURNING FIRE HYDRANTS ON AND OFF

1. Hydrant Wrench
   a. Should be specially designed to fit the hydrant operating nut
   b. Adjustable or open end wrenches should not be used
      (1) Purpose is to prevent damage to hydrant operating nut
      (2) Damage to operating nut may prevent use of hydrant when needed
2. Precautions Before Hydrant is Turned On:
   a. When removing outlet caps prior to making hose connections:
      (1) Loosen cap with hydrant wrench, stand to one side of hydrant and turn cap slowly counterclockwise
      (2) If cap turns freely, continue to remove it
      (3) If cap turns hard, hydrant may have a leaking valve or may not be completely shut off. If so, place hydrant wrench on operating nut and pull down snugly
      (4) Stand to one side and remove cap slowly
      (5) Tighten remaining caps before water is turned on
3. Turning on Hydrant
   a. Note direction of arrow on hydrant bonnet
      (1) This will indicate the direction to turn the stem
      (2) Some hydrants open clockwise and some counterclockwise
   b. Hydrants that open against the pressure
      (1) First turns will be the hardest
      (2) After the valve leaves the seat, water will flow to the top of the valve equalizing pressure on both sides
      (3) After pressure is equalized, stem will normally turn freely
      (4) Always completely open the hydrant
         (a) Turning on may require 15 to 20 complete revolutions
         (b) Failure to make the last two or three turns, may rob you of several hundred gallons of water. This also will create excessive pressure around the hydrant valve, causing excessive wear

Instructor's Notes

- (5) Many hydrants open with the pressure and do so efficiently

4. Turning Off Hydrants
   - a. On the final turn when shutting hydrant down:
     - (1) Pull the valve stem down snugly
     - (2) Excessive tightening is not necessary if valve and valve seat are in good condition
     - (3) Excessive tightening may damage the bronze operating nut, rendering the hydrant inoperable
5. After Hydrant is Turned Off:
   - a. Hydrant man should observe water level inside of discharge nipple to make sure hydrant is draining
   - b. If water level rises and flows out of the nipple, hydrant may not be completely shut off or an obstructing particle may be lodged under the valve:
     - (1) Try to gently close the hydrant further
     - (2) If water level does not fall, try flushing hydrant to remove any obstructing particle
   - c. If water level falls, hydrant is draining properly
   - d. If hydrant fails to drain, make a report to the hydrant maintenance department
   - e. Hydrants that turn off with the pressure, will normally turn freely until the last half turn where additional resistance will be met

F. INSPECTION AND TESTING OF FIRE HYDRANTS

1. Inspection Procedures
   - a. Communities where fire department personnel do not inspect hydrants
     - (1) Fire chief should be sure that some department will be responsible for hydrant inspection and maintenance
   - b. Suggested procedures for fire departments who do inspect hydrants
     - (1) The semi-annual inspection (April and October)
     - (2) The winter daily inspection (October to April)
     - (3) The summer weekly inspection (April to October)
     - (4) The new installation inspection, including annexation
     - (5) The after repair inspection, including floods
2. Semi-Annual Inspection
   - a. Check operating features of each hydrant after six months of winter
   - b. Repeat after six months of summer

Instructor's Notes

- c. Make a visual inspection of the barrel, caps, chains and secondary valves for any defects
    - (1) Some departments remove the cap chains as they sometimes interfere with the turning of the cap

3. Winter Daily Inspection
    - a. Objective is to prevent freezing
    - b. Checked to see if partially filled or full of water
    - c. Excessive water should be pumped out
4. Summer Weekly Inspection
    - a. Checked for condition of component parts
    - b. Removal of weeds within a four foot radius of the hydrant
    - c. Check condition and location of secondary valve cover
5. New Installation Inspection and Annexation
    - a. Checked for compatibility of threads
    - b. Should be tested for water flow and flushed to clear main of stones or foreign materials
    - c. Checked for correct positioning of discharge outlets
    - d. Follow same procedure for hydrants inherited through annexation
6. After Repair and After Flood Inspection
    - a. To determine if secondary valve is fully open and hydrant is ready for service
    - b. To make sure original defects were corrected
    - c. Secondary valves should be shut off during flood situations
    - d. When flood waters recede, open valve and restore to normal operation
7. Tools and Supplies Used for Inspection
    - a. One 8 inch crescent wrench
    - b. One medium size screw driver
    - c. A one quart oil can filled with three parts lubricating oil to one part coal oil
    - d. Regulation size hydrant wrench
    - e. Hydrant pump
    - f. Extra top nuts and top screws
    - g. Hydrant caps and chains
    - h. Notebook or prepared inspection form

      ***REFER** learners to Fig. 8, p. 77, Fire Service Training (text).*
    - i. Rag of medium size and stiff scrub brush
8. Servicing Hydrant
    - a. Remove top-nut or oil screw (if either is provided) with the crescent wrench or the screw driver
        - (1) Replace with new one when required

Instructor's Notes

- b. Pour a small amount of oil into oil hole and replace the top-nut or the oil screw, whichever applies
    - (1) If alemite fitting, lubricate

REFER learners to Fig. 9, p. 78, Fire Service Training (text).

- c. Remove all discharge caps and clean all threads with rag and stiff brush
- d. Replace all hydrant caps tightly except one from which water will test flow
- e. Use regulation size hydrant wrench to flow test the hydrant
    - (1) This need not be the full flow from the hydrant especially when this operation might result in damage to property
    - (2) Also, consideration must be given to the fact that this function most generally muddies the water in the main, making it unfavorable for domestic use
- f. The hydrant pump is used after the hydrant has been flow tested in October to prevent the water from freezing during the cold weather months
    - (1) This is not necessary in the April servicing
- g. Where required, broken hydrant caps and missing chains should be replaced
- h. Cap chains should work freely

9. Pressure Test
    - a. Pressure test the hydrant after flushing
        - (1) A tapped hydrant cap with gauge attached should be placed on one outlet
        - (2) All other outlet caps fully tightened
        - (3) Open hydrant completely, observe and record pressure reading on the gauge
        - (4) Check hydrant for leaks
        - (5) Shut hydrant down and check for proper draining
        - (6) Use female hose coupling to check condition of outlet threads
10. Inspecting Hydrants with Gate Valves
    - a. Normally found on hydrants with more than two 2-1/2" outlets

REFER learners to Figs. 10 & 11, p. 79, Fire Service Training (text).

11. Inspecting Defective Hydrants
    - a. Leaning hydrant
        - (1) Indication of damage
        - (2) Should be checked and a report made to superiors
    - b. Stripped bronze stem nut
        - (1) Easily recognized, stem will turn freely

Instructor's Notes

(2) Will not open or close the hydrant valve

REFER learners to Fig. 9, p. 78, Fire Service Training (text).

(3) If stem strips while opening the hydrant, secondary valve will have to be closed until repairs are made

12. Hydrant Valve Defects
    - a. Caused by valve sticking or foreign material lodged between valve and seat
        - (1) Flushing may eliminate latter situation
        - (2) If leaking cannot be stopped, secondary valve should be closed
            - (a) Reported as O.I.S. (off in street)
    - b. Some departments use small metal tags to mark hydrants out-of-service

REFER learners to Figs. 12 & 13, p. 80, Fire Service Training (text).

13. Frozen Hydrant
    - a. Should be thawed immediately, if possible, or a report made to the maintenance department
    - b. Thawing should not be attempted unless proper equipment is used
14. Secondary Hydrant Valves
    - a. Should be inspected and location recorded
    - b. Hydrants located in areas subject to flooding, should be recorded and secondary valve shut off if flooding is imminent
        - (1) Will eliminate danger to water system if struck or broken off by a boat, log, etc.

G. FIRE FLOW TESTS

1. Area Testing
    - a. Conducted to determine volume of water available to fire departments in certain areas
        - (1) Usually involves not over six hydrants
        - (2) All hydrants are flowed simultaneously and the quantity of water discharged is measured
        - (3) Pressure in the main is checked before and during the test, usually on a hydrant in the center of the group
        - (4) Results of tests are of great value to Chief and Company Officers
2. Flow Tests Using Pitot Tubes and Gauges
    - a. Engineers of the N.B.F.U. and insurance rating bureaus use Pitot tubes and gauges to determine velocity pressure at flowing hydrants

Instructor's Notes

(1) If Pitot tube is not available, a gauge attached to an extra cap can be placed on one outlet and water flowed from the other outlet
REFER learners to Fig. 14, p. 81, Fire Service Training (text).

(2) Pressure reading on gauge should be observed while hydrant is flowing

(3) If a Pitot tube is used, the water pick up tube should be placed in the center of the stream flowing from the outlet

(4) After flowing pressure reading is obtained, discharge can be determined from chart
REFER learners to Fig. 15, p. 81, Fire Service Training (text).
EXAMPLE - Pressure reading is 16 pounds and the size of the outlet is 2-1/2" - Discharge is 670 G.P.M.

b. If an area is to be flow tested, several Pitot tubes or tapped hydrant caps with gauges should be available
REFER learners to Fig. 16, p. 82, Fire Service Training (text).

(1) Static and residual pressure in the main during a flow test is taken at a central hydrant. No water is flowed from this hydrant
REFER learners to Fig. 17, p. 82, Fire Service Training (text).

c. Purpose of test is to determine how many fire streams can be supplied

3. Visual Hydrant Flow Test
   a. Can be made without use of gauges
   b. Test effective on dead end mains
      (1) Place one man at dead end hydrant
      (2) Place another man at a hydrant within 500 feet
      (3) Remove largest outlet cap from both hydrants
      (4) Man at dead end opens hydrant fully
      (5) Other man is signalled to open hydrant fully
   c. If flow from dead end continues to flow at near capacity, a third hydrant can be opened
   d. Observation of flow from each hydrant will present an accurate conclusion as to water supply available to the area
   e. Before making any hydrant flow tests, consult the water department superintendent for special information pertaining to the local water system
   f. Care should be taken not to damage surrounding property

STEP III - APPLICATION

Have learners work Assignment Sheet No. 5 in the Learner's Workbook.

Instructor's Notes

STEP IV - CHECKING AND FOLLOW-UP

Review Assignment Sheet No. 5, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #6

STANDPIPE AND HOSE SYSTEMS, SPRINKLER EQUIPMENT AND AUTOMATIC ALARMS

OBJECTIVES:

1. To present to all firemen a basic knowledge of the purpose and operation of Standpipe and Hose Systems, and Sprinkler Systems and Automatic Alarms.
2. To develop the understanding by firemen that Standpipe and Hose Systems, and Sprinkler Systems and Automatic Alarms constitute the first line of defense wherever they are installed.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Sprinkler Tools, Heads, Tongs and Wedges

REFERENCE:

Fire Service Training (text), Chapter 6, pp. 83-101.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Standpipe and hose systems, sprinkler systems and automatic alarm systems provide firemen with a ready means and adequate method to approach the seat of the fire. At the same time, they protect the exposures and prevent the spread of fire.

The basic knowledge of how these systems operate, along with the "know-how" of what to do and how to do it, is essential for all firemen, not for only a select few.

STEP II - PRESENTING THE LESSON:

A. STANDPIPE AND HOSE SYSTEMS
   1. For use by fire department and other personnel trained to handle this equipment
   2. It can be used by occupants of a building as first aid fire protection for the control of small fires
   3. Standpipe Systems are classified as follows:
      a. Wet standpipe systems having the supply valve open and a water pressure maintained at all times
      b. Dry standpipe system having no permanent water supply

Instructor's Notes

4. Standpipes properly located and maintained are of value to a fire department in reducing the time required to put hose lines into action on upper floors of tall buildings
    a. Where the fire department is equipped with pumping engines or where other high pressure water supplies are available from water works, etc.
    b. The size of the standpipe depends upon the needs
5. Standpipe and Hose Connections
    a. Number and arrangement governed by local conditions
    b. Located on each floor
    c. Not more than 100 feet of hose should be attached
    d. Each portion of the building should be within 30 feet of the nozzle
    e. Hose stations should not be over 6 feet above floor
    f. Approved valves are provided between the main riser and branch hose outlets
       REFER learners to Fig. 1, p. 84, Fire Service Training (text).
    g. Cabinets should be used for fire equipment only and properly marked
    h. Explain wall hydrant. One 2-1/2 hose outlet for each 250 gallons of stationary pump capacity
       REFER learners to Fig. 2, p. 84, Fire Service Training (text).
    i. Operating pressure should not exceed 100 lbs. on 1-1/2 inch hose, 50 lbs. on 2-1/2 inch hose
    j. Threads on standpipe outlets should be compatable with those of the fire department
    k. Nozzles for standpipe systems:
        (1) Should be approved type
        (2) Small lines should not be over 1/2 inch
        (3) Large lines should not be over 1 inch to 1-1/8 inch
        (4) Combination nozzles are advantageous where solid stream may contribute to fire spread or where flammable liquids are prevalent
        (5) Shut-off nozzles may be desirable where water damage is of major consideration
        (6) Hose connections on dry standpipes should be provided with a conspicuous, durable and permanently legible sign reading "DRY STANDPIPE FOR FIRE DEPARTMENT ONLY."
6. Character of Water Supplies - Wet Standpipe Systems
    a. Wet Standpipe systems (other than dry pipe systems) should have:
        (1) An approved water supply

Instructor's Notes

(2) Preferably, two independent sources

(3) A single source of supply may be used where it is capable of automatically supplying all the fire streams required for the full protection of property

b. Acceptable water supplies may be:

(1) Public water works system where pressure is adequate

(2) Automatic fire pumps

(3) Manually controlled fire pumps in combination with pressure tanks

(4) Pressure tanks

(5) Gravity tanks

(6) Manually controlled fire pumps operated by remote control devices

c. Minimum volume using 1-1/8" tip on 2-1/2" hose

(1) 250 g.p.m. for one standpipe for a period of 30 minutes

(2) 500 g.p.m. when two or more standpipes are required for a period of 30 minutes

d. Required pressure

(1) Sufficient to insure 40-50 p.s.i. at topmost outlet while discharging through 50 feet of 2-1/2 inch hose with a 1-1/8 inch tip

(2) Less than 20 p.s.i. at the topmost outlet is considered inadequate

e. Outside fire department connections

(1) At least one outside connection for each standpipe system

(2) Fire department pumpers may pump into the system to maintain an adequate supply

(3) Provided with approved straightway check valve located in building or valve pit, but not with a gate valve

(4) A drain should be provided between check valve and outside hose connections

f. Water supply connections from tank, pump and waterworks system

(1) Provided with approved gate and check valves located close to supply

(2) Where feasable, supply from waterworks should include post indicator valve

(3) Post indicator valves and other control valves should be plainly marked to indicate the service they control

Instructor's Notes

(4) Should be equipped with approved gauges to indicate available pressure
(5) Main supply valves shall be open at all times

g. Hose station inspections
- (1) Valves should be frequently inspected for:
  - (a) Leakage at hose valves
  - (b) Drainage holes not clogged
- (2) Hose should be re-racked at 60 day intervals
  - (a) To change position of folds
  - (b) New gaskets to be installed when required

h. Standpipes out-of-service
- (1) When a standpipe is out of service for any reason, notice should be given to the local fire department
- (2) A sign should be posted on each fire department connection indicating that the standpipe is out-of-service

7. Standpipe installations in Buildings Under Construction
   - a. Tall buildings while in the process of construction offer a very serious problem to the fire department in fighting fires at the higher levels
     - (1) A standpipe system, either temporary or permanent in nature, should be installed before the building has reached a height of approximately 70 feet or six stories above the street grade and carried up with each floor
   - b. Other factors to be considered are:
     - (1) Standpipes shall be securely and adequately supported at each alternate floor
     - (2) Two-way 2-1/2 inch siamese connections should be provided at ground level
     - (3) At each floor level there shall be provided at least one approved hose valve for attaching fire department hose
       - (a) Valves should be closed at all times when not in use
     - (4) Standpipe systems shall be carried up with each floor in buildings under construction
       - (a) The system shall be securely capped at the top
     - (5) At the highest hose outlet, a box containing a supply of hose, a nozzle, a spanner wrench and hose straps should be maintained
     - (6) Temporary standpipes shall remain in service until the permanent one is completed

Instructor's Notes

(7) Where fire department intake connections are not readily visible from the street, a sign should be posted in directing a fire department to such connections

(8) In large building of great height, telephone systems are often provided as a means of communication during the construction period

8. Special Types of Dry Pipe Standpipe Systems
   a. A combination foam and water system is sometimes installed at bulk gasoline service stations
      REFER learners to Fig. 5, p. 87, Fire Service Training (text).
      (1) This illustration portrays an automatic operating system that can be augmented through the use of fire pumpers connected to hydrants from which water is pumped into the system through 2-1/2 inch hose lines connected to a battery of intakes
   b. Are often installed on large bridges, cold storage plants, and large areas such as stock yards
      REFER learners to Fig. 6, p. 89, Fire Service Training (text).
      (1) This illustrates a dry pipe system having intakes on both sides of the bridge with division valves and discharges inserted for efficient operation and use

9. Fire Department Procedures at Buildings Equipped with Standpipes
   a. Pre-fire planning and inspection
      (1) Identify and locate all standpipe systems in the area served
      (2) Locate fire hydrants and other water supplies
      (3) Confer with management and maintenance supervisor on an inspection program to keep the system in good order
      (4) Develop a training program for fire extinguishment using a standpipe system
      (5) Observe structural changes in a building in relation to the standpipe system and report changes to persons concerned
      (6) Inspect all hose connecting outlets and intakes
         (a) Match test all hose connection threads
         (b) Distinguish the siamese intakes whether they are for the standpipe system, wall hydrant or sprinkler intakes
   b. During the fire
      (1) One or two 2-1/2" hose lines shall be laid from the pumper and connected to the intake of the standpipe

Instructor's Notes

(a) Other hose lines may be laid from the pumper direct to the fire, if practical

(2) Water is started into the standpipe systems on orders of the chief officer at the fire

(3) When so ordered the pump operator shall compute the pump pressure, by allowing 50 p.s.i. nozzle pressure, plus elevation and friction loss

(4) When preparing to work from a standpipe system, the equipment most generally needed are:
- (a) 2 sections of 2-1/2" hose
- (b) Playpipe, shut-off nozzle and tip
- (c) One or two sections of 1" or 1-1/2" hose, plus the necessary fittings to make the desired connections
- (d) Connect hose to standpipe discharge outlet one floor below fire if necessary. Use house hose line or fire department hose

(5) DESCRIBE the precautions to be taken in reaching the fire floor when using an elevator:
- (a) Stop at floor below fire
- (b) Don't rush out of elevator
- (c) Advance to fire floor via stairway or fire escape

(6) The officer-in-charge may alter the above procedure, depending on circumstances

c. After the fire
- (1) Close the control valve being used
- (2) Disconnect fire department hose, if used, and replace with house hose lines
- (3) With the aid of maintenance personnel drain the dry standpipe system
- (4) Recheck all valves before returning to quarters

B. SPRINKLER EQUIPMENT

1. "Sprinkler equipment consists of a series of pipes connected and inter-connected, filled with water or compressed air, and equipped for automatic devices to release water for fire fighting purposes from one or more sprinklers"
   - a. Generally, a sprinkler system covers an entire property, and therefore, affords a ready and effective means of delivering water at the seat of the fire

REFER learners to Fig. 7 p. 90, Fire Service Training (text).

2. The value of sprinkler protection in safety to life and in safeguarding property is receiving increased recognition on a nationwide scale

Instructor's Notes

- a. EMPHASIZE that large industries are moving to rural territory where they may have sprinkler protection in their newly constructed plants

3. Along with this swing to sprinkler protection, there arises the need for greater appreciation by the fire department of the tremendous value and protection by sprinklers on pre-planning and actual fire fighting operations
4. Water Supplies
   - a. Supplied by fire department pumper
     - (1) Used to supplement automatic supply
     - (2) Through siamese connection
       - (a) Located outside of building
       - (b) Siamese connections should be approved type
       - (c) Conforming to the standards of local fire departments, threads, etc.
       - (d) EXPLAIN identification of siamese connection so that intended system is supplied

         REFER learners to Figs. 8 & 9, pp. 90 & 91, Fire Service Training (text) and EXPLAIN.
   - b. City water

     REFER learners to Fig. 10, p. 91, Fire Service Training (text), see para. 2, col. 2, p. 91 and EXPLAIN.
   - c. Gravity tank

     REFER learners to Fig. 11, p. 92, Fire Service Training (text) and EXPLAIN, EMPHASIZING winter precautions.
   - d. Pressure tank

     REFER learners to Fig. 12, p. 92, Fire Service Training (text) and EXPLAIN.
   - e. Fire pumps in buildings

     REFER learners to Fig. 13, p. 93, Fire Service Training (text) and EXPLAIN.
   - f. Other features
5. Types of Systems
   - a. EXPLAIN wet-pipe
   - b. EXPLAIN dry-pipe
   - c. Pre-action and deluge
     - (1) Receives source of water supply in same manner as wet or dry systems
     - (2) Activated by "rate-of-rise" system
       - (a) 15 degrees in one minute
     - (3) Both are dry under normal conditions
     - (4) In pre-action system it is filled with water
       - (a) Pre-action system has sprinkler heads which are fused

Instructor's Notes

(5) Deluge system has sprinkler heads, not fused, and are open at all times

d. Special types and designs of systems

(1) Water curtain

(2) Carbon dioxide

(3) Foam

(4) Special system inside of a transformer station

(5) Mulsifyer for an outdoor transformer station

6. Other features of sprinkler systems

a. Post indicator valve

b. Outside screw and yoke valve

c. Floor control valves

d. Standard identification signs

7. Sprinkler Heads

a. EXPLAIN temperature ratings and color

REFER learners to chart on p. 96, Fire Service Training (text) or may be placed on chalkboard.

(1) Another type of link is the Quartzoid, a transparent bulb composed largely of quartz, nearly filled with liquid, when expanded by heat will shatter the bulb

(a) The bulb is used to hold the disc in place instead of struts or levers

b. EMPHASIZE that sprinkler heads should be of proper temperature rating for the particular hazard

c. Sprinkler heads should be kept clean, not painted, white-washed or otherwise coated

d. Sprinkler heads should be covered with a paper bag where exposed in paint spray booths, etc.

C. SPRINKLER ALARMS

1. EXPLAIN the Two Types of Alarms, Water Motor or Electric

2. Water flow alarms should be provided on all sprinkler installations

a. Central station water flow alarm service is desirable, but does not necessarily waive the local alarm requirements

3. Either an outdoor water motor or electric alarm gongs should be installed in every case where a sprinkler system is not provided with an approved water flow alarm to a central station

4. May be a direct line to local fire department station

5. EXPLAIN - Wet-pipe system alarm valve

REFER learners to Fig. 16, p. 97, Fire Service Training (text).

Instructor's Notes

6. EXPLAIN - Dry pipe system alarm valve
   REFER learners to Fig. 17, p. 98, Fire Service Training (text).
7. EXPLAIN - Rate-of-rise Alarm
   REFER learners to Fig. 18, p. 98, Fire Service Training (text).

D. FIRE DEPARTMENT PROCEDURES

The scope of fire department training should be broadened at all levels to include a need for adjustment of procedures and practices to take full advantage of sprinkler equipment for maximum protection. Toward this end, the planning and operations of any fire department could be developed through the application of the following check list:

1. Pre-Fire Planning
   a. Identify and locate all sprinklered property
   b. Know all areas not protected by sprinklers
   c. Locate siamese intakes
   d. Locate fire hydrants nearby, and know their limitations in terms of g.p.m. available
   e. Have management designate what local person or persons to be available to replace sprinklers and reset dry valve when necessary
   f. Conduct classroom training programs to include sprinkler inspection procedures
   g. Fire department should be notified when sprinkler system is shut down for any reason
2. Sprinkler Inspection Procedures
   a. Determine that sprinkler equipment is in operating condition
      (1) All control valves must be open and valve seals intact
      (2) Check gauges for proper pressure
      (3) Fire inspector should be accompanied by assigned company employee
   b. Inspect all areas to determine where sprinkler protection is and is not provided
   c. Inspect for obstruction
   d. Check for structural and stock storage changes
   e. Inspect the siamese intake connections and clapper valves
   f. Check the supply of extra sprinkler heads
      REFER learners to Fig. 19, p. 100, Fire Service Training (text), EXPLAIN and DISCUSS.
   g. Sprinkler systems are tested annually, at a normal pressure of 250 pounds.

Instructor's Notes

3. During the Fire
    a. Connect supply line or lines from pumper to siamese connection
        (1) A 750 gallon pumper can supply only about 35 activated sprinkler heads
        (2) A 1,000 gallon pumper about 50 activated sprinkler heads
        (3) The recommended pump pressure to sprinkler systems is 150 pounds.
    b. Where the fire involves a large area
        (1) Additional pumpers should be connected to other siamese intakes
    c. Do not rob water supplied to sprinkler system in order to supply hose lines
    d. Avoid premature shutting off of sprinkler system
    e. When sprinkler system is shut off, a fireman should stand by the control valve until all danger of rekindling has passed
        (a) When possible, a man should remain at the control valve until the system is restored to normal
4. After the Fire
    a. Close the riser control valve
    b. Drain the system
    c. All fused sprinkler heads should be replaced
    d. Maintenance man should reset dry valve
        (1) In winter a fireman or other responsible person should remain at the riser location
            (a) In case another fire develops
        (2) In summer the system may be allowed to remain full of water and operate as a wet system
            (a) Until dry valve can be reset

E. WATER DISTRIBUTION IMPROVEMENTS
1. Sprinklers were redesigned in 1952 and 1953
2. Resulted in greatly improved water distribution
    a. New type spray head developed and approved
        (1) As a replacement head or for new installations
        (2) Divides water into finer particles for more rapid heat absorbtion
        (3) Provides greater coverage
            (a) Reduces number of heads by 25% in new installations
        (4) Little or no water is discharged upward to wet the ceiling
3. New sprinklers may be used in old installations

Instructor's Notes

4. **Old type sprinklers cannot be used on new installations**
NOTE: If possible, visit a building or buildings where the operation of both a standpipe system and a sprinkler system can be shown to the learner . Secure permission of building owner before visiting same.

STEP III - APPLICATION

Have learners work Assignment Sheet No. 6 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOWUP:

Review Assignment Sheet No. 6, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #7

FIRE PUMPS

OBJECTIVES:

1. To acquaint the learner with the various types of fire pumps in the fire service.
2. To study mechanical and scientific principles of the various types of pumps.
3. To learn how to operate, interpret gauge readings and maintain the various types of pumps.
4. To understand the importance of using the proper size hose when supplying various size nozzles both straight stream and fog.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Pump charts
3. Film and slides if available
4. Models of pumps if available

REFERENCE:

Fire Service Training (text), Chapter 7, pp. 102-117.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

The fire pump is probably the most essential piece of equipment in any Fire Department. Proper maintenance and operation of pumps is of the utmost importance to the success of any fire department and this subject should be studied quite thoroughly.

A good knowledge of the pump may mean the difference between success and failure. A sufficient number of operators must be available in all fire departments to meet the needs of the community to be served. These operators must be efficient not only in the operation but also in the care of the pump.

STEP II - PRESENTING THE LESSON:

A. IMPORTANCE OF FIRE PUMPS
   1. EXPLAIN Purpose of Fire Pump
      a. To draft water
      b. To increase hydrant pressure

Instructor's Notes

2. EXPLAIN Use of Fire Pump
   a. To move water from a source to the fire, whether it be from a hydrant, lake, pond, booster tank or a tanker
   b. To supply water at the correct volume and pressure through various size hose lines to various types and sizes of nozzles to form an effective fire stream

B. FAMILIARIZATION WITH LOCATION OF PUMP CONTROLS

This material is not contained in the manual.

1. Controls in the cab for driving and pump operation
   a. Ignition switches
   b. Light switches, emergency and head lights
   c. Road transmission shift lever, pump shift lever
   d. Location of emergency brake control
   e. Various instruments located on the dash panel-ammeter, heat gauge, etc.
2. Controls on Outside of Cab at Pump Operators Panel
   a. Changeover valve (volume, pressure)
   b. Throttle, gauges, tachometer
   c. Discharge valve controls
   d. Bleeder valves
   e. Booster tank to pump valves
   f. Pump to booster line and preconnected 1-1/2" line valves
   g. Relief valve, pressure regulating governor
   h. Priming device

C. TYPES OF PUMPS USED IN FIRE SERVICE

1. EXPLAIN that there are three types of pumps which are reliable for fire service:
   a. Piston pump
   b. Rotary gear pump
   c. Centrifugal pump
2. Pump Capacities
   a. Five general sizes - 500, 750, 1,000, 1,250 and 1,500 gallons per minute
   b. Normally a 2-1/2" outlet for each 250 g.p.m. of rated capacity
      EXAMPLE: 500 g.p.m. - two discharge outlets
3. Pump Classifications
   a. Class A. - 500 g.p.m. or greater are designed to deliver their rated capacities at 150 lbs. pressure at draft
   b. Class B. - Required to deliver their rated capacities at 120 lbs. pressure

Instructor's Notes

c. Practically all pumps built since 1956 are Class A

4. Scientific principles involved in operation
    a. Positive displacement of a liquid
        (1) Rotary gear and piston type pumps
        (2) Both displace a definite quantity of water per stroke or revolution

If department being trained is not equipped with a piston or rotary gear pump, do not spend too much time describing either pump. Few have been manufactured since 1941.

    b. Imparting of velocity to a liquid with a moving object
        (1) Centrifugal pump
        (2) The centrifugal pump does not displace a definite quantity of water per revolution. It may range from zero to maximum delivery
        (3) Equipped with impellers when revolving, turns velocity into pressure
    c. EXPLAIN operation of centrifugal pump

REFER learners to Fig. 4a-b, p. 104, Fire Service Training (text).

5. All pumps are required to deliver their capacities at draft
    a. Meaning that water will be taken from a lake, river or pond into a pump and delivered under pressure through various hose layouts
6. A pump does not suck water into the pump chamber
    a. A result of pressure of the atmosphere, forces water into pump

REVIEW this aspect of physics relating to water.

    b. A column of water 2.31 ft. high will exert a pressure of 1 p.s.i. at its base. Therefore, 1 lb. pressure will elevate a column of water 2.31 ft. high. EXAMPLE - 100 lbs. pressure will elevate a column of water 231 ft.
    c. Atmospheric pressure at sea level is 14.7 p.s.i.
        (1) This atmospheric pressure can force water into a tube where a complete vacuum exists (devoid of all air or matter) and elevate it to a height of 14.7 x 2.31 = 33.95 ft.
            (a) Theoretically, this is true but it is impossible to achieve a perfect vacuum
            (b) For this reason, 25 ft. is considered the maximum lift
            (c) Therefore, in order to draft water with a pump, the air must be removed from the pump chamber

Instructor's Notes

7. Piston and Rotary Gear Pump at Draft
   a. Picture a pump as being in two units
      (1) Intake or suction side
      (2) Discharge side
   b. Since positive displacement pumps have no open waterway between intake and suction side, they have the ability to:
      (1) Pump air from the suction side
      (2) Expel it from the discharge side
   c. Connections and valves on the intake side
      (1) Connections must be tight
      (2) All valves closed
      (3) Hard suction hose must be used (it will withstand external pressures)
   d. Pump operator should:
      (1) Open a discharge valve
      (2) Engage the pump shift lever
      (3) Increase motor speed to 700 or 800 R.P.M.
      (4) Water should be picked up immediately

***NOTE:** At this time, in order that you may follow the format in the Fire Service Training (text), give a brief explanation of the single stage, multiple stage and multiple stage parallel-series centrifugal pumps as follows.*

8. Centrifugal Pump Stages
   a. Single-stage
      (1) Single-stage consists of a single disc like impeller mounted on a shaft driven by pump power unit

          ***REFER** learners to Fig. 4a, p. 104, Fire Service Training (text).*

      (2) As the impeller revolves, water flowing in through the suction tube will enter the eye of the impeller and will be thrown to the outer edge by centrifugal action
      (3) Movement of impeller creates a velocity of the water
      (4) Velocity is converted into pressure as it approaches confining space of the discharge tube
   b. Centrifugal pumps not of displacement type
      (1) There are no valves or other blockades within the pump proper
      (2) Presents an open waterway from suction intake to discharge outlet making it impossible to pump air from the intake side and expel it from the discharge side
      (3) Passageways through the impellers are small

Instructor's Notes

(4) Subject to clogging if foreign matter is permitted to enter into the pump
(5) Clogging will interfere with flow of water
(6) Proper type of screen should be provided to collect foreign materials

c. Multiple-stage

REFER learners to Fig. 5, p. 105, Fire Service Training (text).

(1) Consists of two or more single stage pumps
(2) Connected to each other in series
(3) Discharge of first pump is connected to intake of second pump
(4) Each pump handles the same water
EXAMPLE - 500 g.p.m. enters first stage, pressure is added, the 500 g.p.m. is then delivered into the intake of the second stage where additional pressure is added. The water is then delivered to the discharge outlets of the pumper
(5) The volume remains the same (500 g.p.m.) but the pressure is doubled
(6) There are advantages of this pump over single-stage
  (a) Both stages are mounted on the same shaft but in a divided casing
  (b) Ability to deliver greater quantities of water at higher pressures without excessive speed

Very few Multi-stage midship pumps are built today. The trend in the last quarter of a century has been to the Multistage-parallel and series type Centrifugal Pump.

d. Multi-stage parallel-series pumps

REFER learners to Fig. 6, p. 106, Fire Service Training (text) and DISCUSS.

(1) Parallel operation - Two impellers mounted on the same shaft, so arranged that each impeller can take water from the suction side and discharge it independently of each other, but simultaneously
(2) Series operation - Discharge of first impeller will flow into second impeller at a given pressure and be discharged from the second impeller at twice the pressure and half the volume when compared to parallel operation
  (a) This arrangement is made possible through the installation of a series of flap valves and a transfer valve which is manually operated

Instructor's Notes

(3) Advantages over single-stage and multiple stage
  (a) Can operate at maximum volume or maximum pressure within a close range of speed
  (b) Other centrifugal pumps require quite an increase in motor speed to increase the pressure

9. Centrifugal Pump Operation at Draft and Hydrant

a. Necessity of priming device

REFER learners to Figs 9 & 10, p. 108, Fire Service Training (text) and EXPLAIN.

(1) As previously stated, a centrifugal pump has an open waterway between the intake and discharge side of the pump
  (a) Making it impossible to pump air from the intake side and expel it from the discharge side
(2) This makes it necessary to provide another method of withdrawing air from the pump chamber
(3) Three types of primers are available
  (a) Rotary gear, intake manifold and exhaust primers
  (b) All perform the same service, removal of air from the entire pump chamber

b. Priming pump

(1) Engage pump shift lever
  (a) By making this shift, vehicle motor power is transferred from the road transmission to the pump
(2) All valves should be closed and all connections should be tight on both the intake and discharge sides
(3) Motor speed ranges between 800 - 1,200 R.P.M. depending upon the type of primer

REFER to pump instruction manual.

(4) Engage priming device
(5) Water should be obtained within 30 sec. to 1 min.
(6) When the air has been removed from the pump chamber, atmospheric pressure will force water into the pump, filling the chamber
  (a) Disengage priming device
(7) Speed up motor until 50 lbs. pressure is indicated on the discharge gauge before slowly opening a discharge gate valve

c. Holding prime

(1) As long as the chamber is full of water, all air has been displaced and the pump is primed

Instructor's Notes

(2) To hold prime when hose lines are shut down, do not reduce vehicle motor speed back to an idle
(a) Maintain enough speed to hold a 50 lbs. pressure reading on the discharge gauge

d. If pump cannot be primed and after a complete check has been made, see that all valves are closed and connections are tight
(1) Open booster tank to pump valve
(2) Water from booster tank will help displace air from pump chamber
(3) Engage primer, when water is picked up
(4) Close tank valve

e. Advantages of centrifugal pump over rotary gear and piston pump at hydrant operation
(1) Rotary gear and piston pumps being positive in displacement:
(a) Displaces a definite quantity of water per stroke or revolution
(b) Only a definite amount of water can be moved whether being delivered to the intake side under a head pressure from a hydrant or by atmospheric pressure at draft
(2) Centrifugal pumps have an open waterway
(a) Operate on the principle of adding velocity to the water to create pressure
(b) Accept water under pressure and add to its velocity

EXAMPLE - A centrifugal pump is required to deliver 750 g.p.m. at 150 lbs. pressure from draft at 1,800 r.p.m. If a hydrant would be capable of delivering this volume to the pump at 50# pressure, the pump could deliver the same volume at the same pressure at possibly 1,300 r.p.m.

Many 750 g.p.m. Class A pumps are capable of delivering 1,200 g.p.m. from a hydrant located on a large main of sufficient pressure.

Soft suction hose should be used for hydrant operation. It will expand and withstand internal pressures.

D. PUMP ACCESSORIES
1. DISCUSS Churn Valve
a. Necessary on all positive displacement pumps

Instructor's Notes

   b. Relieves pressure when hose lines are shut off
   c. When open, allows water to by-pass into suction side of pump
   d. Must be closed when priming pumps at draft

2. DISCUSS automatic relief valve
   a. Automatic by-pass around churn valve
   b. Different types of construction but all operate on the same principle
   c. When pressure on discharge side exceeds pressure at which controlling spring is set, valve opens by the pressure permitting the water to flow into suction side of the pump relieving discharge pressure
   d. Relieves temporary excessive pressure when lines are are shut off
   e. Used on positive displacement and centrifugal pumps
   f. Can be set at any desired pressure and will function with any flow of water

3. DISCUSS automatic pressure regulating governor

   REFER learners to Fig. 12, p. 109, Fire Service Training (text).
   a. Used on centrifugal pumps
   b. Reduces motor speed when gate valves are closed
   c. Relieves excessive pressure when lines are shut off
   d. Some can be set at any desired pressure
   e. Some governors will not control pressures at a low setting on centrifugal pumps when operating in a series or pressure position

4. DISCUSS gauges

   REFER learners to Fig. 13, p. 110, Fire Service Training (text).
   a. Necessary to inform operator of performance output
   b. Two types are generally used
      (1) Pressure gauge indicates pressures on the discharge side of the pump. Some pumps have individual discharge gauges for each outlet
      (2) Compound gauges indicate positive and vacuum pressures on the intake side of the pump
   c. If gauge indicator vibrates when in use, close needle valve to a point where gauge gives a steady reading without vibration
   d. Open valves to drain gauges after use
   e. Observation of the intake or compound gauge by the operator when operating from a hydrant is one of his most important duties
   f. To make proper use of the intake gauge
      (1) Notice the pressure on the suction side after hydrant has been turned on, but before a line is charged

Instructor's Notes

(2) This will indicate the static pressure in the water system with no water flowing from the pump

(3) It makes no difference if water is taken through 10 ft. of soft suction or 500 ft. of 2-1/2" hose

(4) The pressure reading will be accurate as long as no water is flowing from the discharge side of the pump

(5) After noting the static pressure, the operator should charge the first line, increase the motor speed until the desired pressure is indicated on the discharge gauge

(6) Then check intake gauge and note the percentage of drop in pounds per square inch

EXAMPLE - Static pressure is 80 lbs., pressure with one line flowing is 75 lbs.

  (a) The latter reading is referred to as residual pressure

  (b) The drop between static and residual pressure has been caused by friction loss occuring in hose or soft suction and water mains on the intake side of the pump

(7) The residual pressure reading indicates the remaining available water supply

(8) At close to a zero reading, hose or soft suction on the intake side will start to collapse, showing that the water supply from that particular hydrant has been exhausted

(9) Try to maintain at least 5 to 10 pounds residual pressure

g. Tachometer

(1) Keeps pump operator informed as to r.p.m.'s

(2) Two types generally used:

  (a) Direct reading tachometer

  (b) Markings on the regular speedometer showing miles per hour when pump is operating at different pressure requirements

5. DISCUSS Transfer Valve

a. Necessary on centrifugal multi-stage parallel-series pumps

b. Indicates volume or pressure operation

(1) Volume position indicates parallel operation of impellers, meaning both impellers are delivering the same amount of water each at a given pressure

(2) Pressure position indicates series operation of

Instructor's Notes

impellers, meaning a given amount of water is discharged from one impeller at a certain pressure (100#) into the second impeller. This impeller adds the same pressure (100#) discharging the water from the pump at 200 lbs.

(3) Selection of proper position of the transfer valve is very important, but relatively easy if pump capacity is known
  (a) Pressure position is when less than half the capacity of the pump is being used
  EXAMPLE - 500 g.p.m. pump delivering from the discharge side less than 250 g.p.m., should be in pressure position
  (b) Volume position is when over half the capacity of the pump is being utilized
  EXAMPLE - 500 g.p.m. pump delivering from the discharge side more than 250 g.p.m., the transfer valve should be in volume position

(4) Tachometer reading will indicate proper position:
  (a) If transfer valve is in volume position when discharge delivery is less than 250 g.p.m., engine speed will be greater than if changed to pressure position
  (b) If transfer valve is in pressure position when discharge delivery is greater than 250 g.p.m., engine speed will be greater than if changed to volume position
  (c) The correct position is indicated when the motor is running at a lesser number of r.p.m.'s

c. More than 90% of all fires require use of only a booster line or 1-1/2" line, requiring volumes of water less than 250 g.p.m.
  (1) Therefore, the transfer valve will be in pressure position over 90% of the time

6. DISCUSS Booster Tanks on Fire Apparatus
  a. Purpose
    (1) Auxiliary supply of water
    (2) Necessary on equipment serving rural areas
  b. Advantages
    (1) Water is available for initial attack
    (2) Most fires can be extinguished in initial stages by small hose streams
    (3) Keeps water loss at a minimum
    (4) In rural areas may be only source of water

Instructor's Notes

- c. Tank capacities

  Ohio Inspection Bureau recommends a minimum of 300 gallons.
  - (1) 200 gallons is the minimum recommended for municipalities
  - (2) 500 gallons is the most popular size for pumpers
  - (3) Should not be much larger than 500 gallons
    - (a) Additional weight of water will affect vehicle performance
    - (b) Tank will occupy space needed for hose and other equipment

7. DISCUSS tankers
   - a. Purpose
     - (1) Only source of water supply in many rural areas
     - (2) Necessary to maintain rural Class A insurance rating
   - b. Capacities
     - (1) 1,000 to 1,500 gallons is the most popular size
     - (2) Many tanker capacities exceed 2,000 gallons
     - (3) Tank should be mounted on suitable chassis because of weight of water when filled
   - c. Equipment and response
     - (1) Tankers should be equipped with a portable booster pump or an engine driven pump
     - (2) Tanker should respond regularly with pumper apparatus
8. DISCUSS portable pumps
   - a. An important accessory for fire trucks
   - b. A necessity for rural fire companies
   - c. Single-stage centrifugal, equipped with an exhaust primer, driven by a gasoline motor
   - d. Uses
     - (1) To draft water from ponds, streams, etc., inaccessible to heavy apparatus
     - (2) Relay to pumpers from ponds, etc.
     - (3) Relay from tanker to pump
     - (4) Remove water from basements, etc.
   - e. Many pumps will deliver 50 g.p.m. at 100 p.s.i. and 200 g.p.m. or more at reduced pressures
9. DISCUSS high pressure pump
   - a. Develop pressures in excess of 600 p.s.i.'s
   - b. Usually 3 or 4 stage centrifugal pump (quantity pump)
   - c. Sometimes separate unit powered by power take-off
   - d. Quantity pump will deliver 60 to 120 g.p.m. at 600 p.s.i.

Instructor's Notes

e. Delivers less quantity at high pressures

f. Little credit is given by rating bureaus for this kind of pump

  (1) Because of its inability to supply large volumes of water

100 p.s.i. is the fog nozzle pressure recommended by most manufacturers. Any Class A pumper is capable of developing sufficient pressure to supply the average fog nozzle and with sufficient volume.

E. GENERAL INFORMATION RELATIVE TO FIRE PUMPS

1. STATE that manufacturers publish an instruction manual regarding operation and care of pumps which should be studied carefully and rigidly adhered to.
2. Each fireman should be familiar with the type of equipment, hose, nozzles, etc. carried on the pumper, the location of same

Have learners prepare a list of the following items on their department pumper.

a. Amount of hose in feet

b. Size of hose,. 1" booster, 1-1/2" C.R.L. 2-1/2" C.R.L. soft and hard suction

c. Nozzles, fog and straight stream; also sizes 1-1/2" and 2-1/2"

d. Size of nozzle tips, straight stream; 1/4", 1/2", 1", etc.

e. Fog nozzle delivery at 100# N.P.

f. Location of all equipment on apparatus

At a later date, request individual members of the class to bring you a certain piece of equipment from the apparatus such as all purpose mask and, etc.

3. REQUEST all members of the group to study and become familiar with the general information on the operation and maintenance of pumps as shown in manufacturer's manual relating to the following:

a. Pumping from draft

b. Connecting hose

c. Priming pump

d. Operating the pump

e. Shutting down the pump

  (1) Always reduce motor speed slowly

  (2) Always close discharge valves slowly

f. Pumping from a hydrant

g. If pumper is equipped with a foam-wet water system, follow manual instructions

Foam playpipes equipped with an eductor tube are available for 1-1/2" hose lines and capable of delivering 550 g.p.m. of foam.

Instructor's Notes

Request that each member operate the pump.

Position apparatus outside of fire station or other suitable location.
Have each member engage pump shift.
Open booster tank valve.
Open discharge valve to supply booster line.
Bring discharge pressure up to 80 to 100 p.s.i.
Have another class member hold booster line and open nozzle.

4. One of the common faults of a pumper when taking water supply from a booster tank, is the inability to develop a discharge pressure
   a. This condition is caused by air being trapped in the pump chamber and being at a greater pressure than the water being discharged from the tank
   b. On most pumpers, this would be 1# p.s.i. (the booster tank has to be elevated 2.31' above the pump chamber to create one pound pressure)
   c. To relieve this condition, open the booster tank valve and engage the priming device when discharge pressure starts to build up
      (1) Then disengage primer

F. PUMPER LISTINGS BY THE NATIONAL BOARD OF FIRE UNDERWRITERS
1. Lists the performance tests of pumpers manufactured throughout the industry
2. Responsible for high standards of performance
3. Led to custom of a fire department to require 3 hours acceptance test
4. Test to be compared with listed performance record from N.B.F.U.
5. Two Methods of Listing Pumpers
   a. Twelve hour test, for new manufacturers and new assemblies
   b. Performance listings, for modified assemblies
      (1) Four hour test of modified assembly is accepted by the N.B.F.U.
6. Form 126 of the N.B.F.U. lists data of a specified pumper
7. Photostatic copy of Form 126 should be made available to the buyer by the manufacturers
8. Listing test may be accepted by rating bureau in lieu of the 3 hour acceptance test
9. Plate attached to side of the apparatus at pump operators panel listing the performance standards of the pump, should be requested by the department purchasing the vehicle

Instructor's Notes

G. PUMPER ACCEPTANCE TEST
1. Every new pumper delivered should be given a three hour acceptance test to verify the manufacturers listed test
2. The three hour acceptance test shall consist of:
   a. Drafting water, not less than a 10 foot lift
      (1) When speaking of a 10 foot lift at draft, this means a vertical lift
      (2) Lift is measured from the surface of the water to the center of the intake tube on the pump EXAMPLE: The pumper may be 35' from the waters edge but only at an elevation of 8' above the waters surface requiring 40' of hard suction to reach the water supply. Even though the water passes through 40' of suction hose, it would only be an 8' vertical lift
   b. Must deliver rated capacity at 150 p.s.i. for two hours
   c. Deliver 70% of rated capacity at 200 p.s.i. for 1/2 hour
   d. Deliver 50% of rated capacity at 250 p.s.i. for 1/2 hour
   e. Short overload test rated capacity at 165 p.s.i.
   f. Any pump assembly defects should be detected during this test

H. ANNUAL PUMPER TEST
1. N.B.F.U. recommends annual test
   a. Same procedure as three hour test
   b. Of shorter duration
   c. A dry vacuum test
   d. Most defects will show up during a draft test
2. Records should be kept of annual tests for comparitive purposes

I . CARE OF FIRE PUMP
1. Weekly test
   a. Check and operate all valves and controls
   b. Operate from booster tank supply (similar to draft)
2. Important to keep pumper in good mechanical condition
   a. When using pump at fires, check:
      (1) All parts for lubrication and adjustment
      (2) Cooling system (water temperature gauge - 180° maximum)
      (3) Drain after use in cold water
      (4) Be thoroughly familiar with all drain cocks

Instructor's Notes

b. After returning to the fire station:
  1. (1) Fill booster tank
  2. (2) Fill gasoline tank
  3. (3) Check the radiator and add antifreeze if needed
  4. (4) Check oil in crankcase
  5. (5) Check oil in priming device
  6. (6) Replace wet and dirty hose with clean dry hose
  7. (7) Tires and batteries should be checked weekly

3. Study carefully and adhere strictly to detailed instructions in manufacturers manual

STEP III - APPLICATION

Have learners work Assignment Sheet No. 7 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP

REVIEW Assignment Sheet No. 7, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #8

FIRE HOSE

OBJECTIVES:

1. To acquaint firemen with the sizes, types and care of fire hose.
2. To familiarize firemen with the proper methods of loading hose.
3. To learn the proper use and handling of hose lines and hose auxiliaries.
4. To learn the importance of maintaining adequate hose records.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Double male coupling
3. Double female coupling
4. Siamese and/or Wye connection
5. Hose clamp
6. Hose jacket
7. Shut-off nozzle
8. Assorted nozzles of the department
9. Rope
10. Hose expansion ring

REFERENCE:

Fire Service Training (text), Chapter 8, pp. 118-145.

Instructor's Notes **STEP I - INTRODUCING THE LESSON:**

Fire hose is one of the most essential items of a fire department. Firemen must be familiar with the construction, care and use of hose because of its importance in successful fire control and extinguishment.

The dependability and life of fire hose is determined by such factors as quality of hose purchased, purpose for which the hose is used, operating pressures used by the department, and care of the hose in quarters and at fires. Leaks in hose lines reduce the effectiveness of the fire streams and leaking lines within buildings may result in unnecessary water damage. Where water supplies are limited and in order to use the available supply to the best advantage, it is essential that no water be wasted by leaking hose or couplings.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. TYPES AND SIZES OF FIRE HOSE

1. Purchasing Fire Hose
    a. Standards set forth by Underwriters Laboratories:
        (1) They should be followed
        (2) Will assure good quality
    b. New hose should be thoroughly tested and examined
        (1) Before putting in service
2. Unlined Linen Hose
    a. Most commonly used for installations at stand-pipes
    DESCRIBE and SHOW sample.
3. Rubber-lined Hose
    a. May be cotton, nylon, or dacron jacket
    b. General purpose hose used by fire departments
    DESCRIBE and SHOW sample.
4. Rubber-lined, Rubber-covered Reinforced Hose
    a. Generally referred to as hard suction hose
    b. It is connected to an intake of a pumper for the purpose of drafting water
    DESCRIBE and SHOW sample.
5. Rubber lined, Rubber Covered Hose
    a. Used for booster, chemical and high pressure lines
    DESCRIBE and SHOW sample.
6. Sizes of Fire Hose
    REFER learners to listing on p. 119, Fire Service Training (text).
    a. DISCUSS sizes and types

B. CARE OF HOSE

1. The length of service obtained from any type or make of hose is dependent on:
    a. The care it is given at fires, on pumpers, and storage procedures in quarters
    b. Good hose will last a long time if not abused and given proper care
2. Ways in which hose may be damaged are as follows:
    a. Mechanical injury
        (1) Cuts, snags, and abrasions from dragging
        (2) Improper folding
        (3) Hoisting over cornices, windows, and roofs
        (4) Chafing - by pump vibration over curbing
        REFER learners to Fig. 1, p. 119, Fire Service Training (text).
        (5) Driving over hose
        REFER learners to Fig. 2, p. 119, Fire Service Training (text).
        (6) No periodic hose load changes

Instructor's Notes

(7) Sudden shut-off at nozzle
(8) Improper storage of extra hose

b. Heat injury
  (1) Effect of heat on rubber
    (a) Avoid high temperatures because of vulcanization
  (2) Damage by embers, cinders, hot machinery, etc.
  (3) Damage by hot oils, greases, chemicals and hot water
  (4) Storage near steampipes and radiators both on trucks or storage
  (5) Improper temperatures of store rooms, drying towers and dryers

c. Mildew and mold
  (1) Improper drying
  (2) Hose on truck should always be dry
  (3) Storage hose must always be dry
  (4) Never store hose in damp places

d. Injury from freezing
  (1) EXPLAIN effect upon jacket when frozen
  (2) EXPLAIN procedure in freeing frozen hose from street

DRAW Fig. 4, p. 121, Fire Service Training (text) on chalkboard.

  (3) EXPLAIN correct method to use in picking up frozen hose
  (4) EXPLAIN how to load frozen hose
  (5) EXPLAIN care of frozen hose upon return to station

e. Chemical damage
  (1) Avoid laying hose in gutters
  (2) Avoid gasoline
  (3) Avoid oil and greases
  (4) Avoid paints
  (5) Avoid acids
  (6) Remove from service until damage extent can be determined

f. Care of hose when not in use
  (1) Methods to prevent deterioration
    (a) Periodic rearrangement of hose loads
    (b) Periodic flowing of water through hose

g. Washing and drying hose
  (1) All dirt should be brushed off each time hose is laid
  (2) Scrub with plain water
  (3) Use mild alkali solution if necessary

Instructor's Notes

(4) Rinse thoroughly
(5) Hose should be dryed
    (a) Use drying rack
    ***REFER** learners to Figs. 5 & 6, pp. 122 & 123, Fire Service Training (text).*
    (b) Use hose towers
    (c) Floor dryers

***REFER** learners to Summary on Care of Hose, p. 123, Fire Service Training (text) and **EXPLAIN** each of the 11 items.*

C. HOSE COUPLINGS

1. Hose couplings are constructed of brass alloy and are attached to the hose by expanding a brass ring
    a. Forcing the hose jacket and lining against the inside of the coupling
    b. The portion of the coupling against which the hose is forced is rough to provide a better grip
    ***SHOW** hose expansion ring and how hose is fastened to coupling.*
2. Care of Hose Couplings
    a. Examine threads after use
    b. Couplings "hand tight" only
    c. No oil or grease on couplings
    d. Wash periodically in mild detergent to remove grit and dirt
    e. Never drop or drag
    f. Protect from vehicle traffic
    g. Elevated lines must be supported
        (1) Each 25 ft.
        (2) At each coupling
        (3) Water in one section weighs 106 pounds
        ***SKETCH** on chalkboard and **EXPLAIN** Fig. 7, p. 124, Fire Service Training (text).*
3. Standard Threads for Hose Couplings
    a. Uniformity is a must
    b. Mutual aid participants:
        (1) Should check couplings
        (2) Special adapters may be needed
        ***DISCUSS** National Standard Fire Hose Coupling Thread table on p. 124, Fire Service Training (text).*
    c. DISCUSS department hose thread sizes with learners
4. Hose Gaskets for Couplings
    a. Should be a soft plastic or rubber
    b. Replace as often as conditions warrant
    c. Buy proper size gaskets
        (1) Inside dimensions
        (2) Outside dimensions

Instructor's Notes

- (3) Thickness
- d. Inspect each time hose is changed or tested
- e. Replace hard gaskets

D. TESTING HOSE
1. New single jacket hose at 300 pounds
2. New double jacket hose at 400 pounds
3. Annual test should be 200 pounds or 50 pounds in excess of normal working pressures
4. Pumper can be used

   REFER learners to Hose Tester, Fig. 8, p. 125, Fire Service Training (text).
5. Pressure should be held for 3 minutes
6. Remove all air from line before test
7. Replace all defective lengths
8. DO NOT TEST all department hose at the same time
   - a. Keep some on truck
   - b. Replace quickly
   - c. Be ready for a fire call

E. HOSE LOADS
1. The basic principle in loading hose in a hose bed is to arrange it so the hose will pay out smoothly when needed at a fire
2. The design or type of load used must conform to the hose load best suited for efficient operations by the local department
3. Horseshoe or U Load
   - a. EXPLAIN how load is made
   - b. EXPLAIN objections
     - (1) Raised places are at front corners
     - (2) Hose is often crushed between layers
     - (3) Not adaptable for shoulder load carry
     - (4) The U Load may form a twist when paying out another layer

   REFER learners to or DRAW on chalkboard Figs. 9, 10, 11, &12, p. 126, Fire Service Training (text) and EXPLAIN.
4. Accordion Load
   - a. Explain objections
     - (1) All bends are sharp
     - (2) Couplings must be placed properly

   REFER learners to or DRAW on chalkboard Fig. 13, p. 127, Fire Service Training (text) and EXPLAIN.
5. Divided Load
   - a. Advantages
     - (1) Lay two lines at one time
     - (2) Can be layed either way reversed or straight

(3) Very good for short lays
b. Disadvantage
(1) Not recommended for long lines
DRAW on chalkboard and EXPLAIN Fig. 14, p. 127, Fire Service Training (text).

6. Combination Load
a. EXPLAIN this load
(1) 2-1/2 and 1-1/2 inch lines are used
(2) 1-1/2 inch may be preconnected
(3) 2-1/2 inch hose can be used as a supply line
REFER learners to Fig. 15, p. 128, Fire Service Training (text).

7. Hose Load Finishes
a. Do-nut roll in connection with standard load
(1) Provides sufficient hose for catching hydrant
(2) First pair of couplings should be in roll
(a) Prevents damage
(b) Prevents injury to man on tailboard
REFER learners to Fig. 16, p. 128, Fire Service Training (text) and EXPLAIN.

b. Skid load finish
(1) Provides extra hose for nozzle man
(2) Weight of skid load helps unload hose as truck proceeds to hydrant
(3) Eliminates waiting time when pulling off hose
REFER learners to Fig. 17, p. 128, Fire Service Training (text) and EXPLAIN.

8. Cross Fold Finish
a. Eliminates friction in hose bed
b. Used in catching hydrant
REFER learners to Fig. 18, p. 129, Fire Service Training (text) and EXPLAIN.

9. Do-nut Roll
a. Describe how it is made
(1) One man
(2) Two man
b. EXPLAIN where it is used
(1) To replace broken section
(2) Legthen line
(3) From pump to standpipe intake
c. EXPLAIN how to put in service
Have learners practice making a Do-nut Roll.

F. HANDLING HOSE LINES

Have learners practice the following hose evolutions at the appropriate time.

1. For efficient and successful fire fighting it is necessary that the handling of hose lines be uniform throughout the department

Instructor's Notes

2. Handling Uncharged Hose Lines
   a. Catching the hydrant
      (1) While this is a simple operation, there are some points and safety hints worth considering
         (a) Driver should stop near curb at hydrant
         (b) Grasp hose with hand farthest from hydrant
         (c) Loop hose around hydrant
         (d) Place foot on hose near coupling, See Fig. 22, page 130
         (e) Loosen cap
         (f) Place hydrant wrench on operating nut
         (g) Remove cap and connect hose

REFER learners to and EXPLAIN Figs. 23a and 23b, p. 131, Fire Service Training (text).
Have learners PRACTICE catching hydrant using do-nut roll hose load, if applicable.

   b. Coupling hose

EXPLAIN and DEMONSTRATE how to couple hose, REFER learners to Figs. 24 & 25, p. 131, Fire Service Training (text).

      (1) Position of man
      (2) Precautions
   c. Putting on the nozzle

EXPLAIN two methods, REFER learners to Figs. 26 & 27, p. 132, Fire Service Training (text).

      (1) Methods to follow
         (a) Position of man
         (b) How to hold coupling
         (c) How to hold nozzle
   d. One man section hose carry

EXPLAIN and DEMONSTRATE this carry, REFER learners to Fig. 28, p. 132, Fire Service Training (text).

      (1) When and where used
      (2) Method of doing
      (3) Precautions
         (a) Hose coupling damage
   e. Laying short lines by hand straight-away

EXPLAIN and DEMONSTRATE this lay, REFER learners to Fig. 29, p. 134, Fire Service Training (text).

      (1) When, where and why it is used
      (2) May need double male coupling
   f. Laying a line when shorthanded

EXPLAIN and DEMONSTRATE lay, REFER learners to Fig. 30, p. 135, Fire Service Training (text).

      (1) Why used
      (2) May drag from waist
   g. Shoulder hose carry

EXPLAIN and DEMONSTRATE this carry, REFER learners to Fig, 31, p. 135, Fire Service Training (text).

Instructor's Notes

(1) Where and why used
(2) Must be accordion load or layed on ground and then picked up
(3) Allow 50 ft. section for each floor

h. Advancement of 2-1/2 inch hose up a ladder
EXPLAIN and DEMONSTRATE this operation, REFER learners to Fig. 32, p. 136, Fire Service Training (text).
(1) Where, when and why used
(2) Secure before line is charged
(3) Nozzle should be placed over left shoulder with the hose under right arm and over right hip

3. Handling Charged Lines
DISCUSS and EXPLAIN the 6 items listed on p. 137, Fire Service Training (text), stress safety.

4. Fire Escape Evolution
EXPLAIN and DEMONSTRATE evolution, REFER learners to Fig. 34, p. 138, Fire Service Training (text).
a. Special pike pole is used
b. 50 ft. of extra hose at top floor

5. Working a Charged Nozzle through a Ladder at a Window
EXPLAIN and DEMONSTRATE two methods, REFER learners to Figs. 35 and 36, p. 139, Fire Service Training (text).

6. Replacing a Burst Section of Hose or Extending a Line
EXPLAIN and DEMONSTRATE using a hose clamp.
a. Where, when and why used

7. Advancing Charged Line using the Slack Roll Method
EXPLAIN and DEMONSTRATE, REFER learners to Fig. 38, p. 140, Fire Service Training (text).
a. When, where and why used
ALL previous Hose Evolutions MUST be PRACTICED by all learners.

8. Keenan Hose Loop
EXPLAIN and DEMONSTRATE, REFER learners to Fig. 39, p. 140, Fire Service Training (text).
a. When, where, and why used

G. HOISTING LINES

1. Hoisting Charged Lines
EXPLAIN and DEMONSTRATE, REFER learners to Fig. 40, p. 141, Fire Service Training (text).
a. Attach rope below coupling
b. Tie shutoff

2. Hoisting Uncharged Lines
EXPLAIN and DEMONSTRATE, REFER learners to Fig. 41, p. 141, Fire Service Training (text).

Instructor's Notes

a. Protect tip
b. Point nozzle down
c. Leave knot tied to hose for support

H. HOSE AUXILIARIES

1. Double Male and Female Couplings
   EXPLAIN and DEMONSTRATE uses.
   a. Reverse lays
   b. Saves time
   c. Saves work
2. Siamese and Wye Connections
   DESCRIBE and SHOW difference. REFER learners to Figs. 42 and 43, p. 142, Fire Service Training (text).
3. Hose Clamp
   Show clamp and explain uses.
   a. To stop flow of water in line without shutting the water off at the source of supply
      (1) Replace burst sections
      (2) To extend hose lines
      (3) To change nozzle
      (4) To clean clogged nozzle
      (5) Others
   b. As an aid in laying line to pump
      (1) Catch hydrant as usual
      (2) Pumper proceeds to fire
      (3) Pump operator places clamp on hose at rear of truck
      (4) Hydrant man can turn on water and advances to the nozzle
      (5) Pump operator breaks connection and makes connection to pumper
      (6) Pump operator removes clamp
4. Hose Jacket
   EXPLAIN and DEMONSTRATE the hose jacket (See Fig. 44, p. 143, Fire Service Training (text).
   a. Where, why and how used

I. FIRE DEPARTMENT HAND SIGNALS

EXPLAIN and DEMONSTRATE the following signals in Fire Service Training (text), pp. 143 and 144:

Fig. 45a Boosterline (day)
45b Boosterline (night)
46a Turn water into line (day)
46b Turn water into line (night)
47a Shut off water (day)
47b Shut off water (night)

Instructor's Notes

48a Increase pressure (day)
48b Increase pressure (night)
49a Lower pressure (day)
49b Lower pressure (night)

J. HOSE RECORD FILE CARD

1. Every fire department should keep hose record
2. For each section of hose
3. Ohio Inspection Bureau utilizes hose records
4. Provides data for determining the need for new or additional hose

REFER learners to and EXPLAIN Hose Record Card, Fig. 50, p. 145, Fire Service Training (text).

STEP III - APPLICATION

Have learners work Assignment Sheet No. 8 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW UP

REVIEW Assignment Sheet No. 8, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #9

TOOLS AND EQUIPMENT

OBJECTIVES:

1. To develop in each learner the ability to use the various tools and appliances to the best advantage and in the safest manner.
2. To convey to the learner the limitations and characteristics of the different tools and the proper care of each.

TEACHING AIDS:

1. Chalkboard, chalk and eraser; or chart pad
2. A prepared list of all minor equipment in the department and where it is carried or mounted on the trucks
3. Samples of all minor equipment in the department
4. Manufacturer's manuals on special equipment

REFERENCES:

Fire Service Training (text), Chapter 9, pp. 146-158.
Manufacturers manuals on special equipment.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

It is essential that each fireman knows the proper use, care and maintenance of small tools and appliances used in the fire service for successful fire fighting operations.

The correct tool should be used in the proper manner to perform a certain operation safely and efficiently. When new equipment is purchased it should be of the highest quality and requires proper and continuous maintenance thereafter.

STEP II - PRESENTING THE LESSON:

Assign different men to obtain tools from trucks and bring to a designated area.

SHOW and DEMONSTRATE how to use all tools carried by the local department. If a particular tool is not available refer the class to the illustration of that tool in the manual.

Instructor's Notes

A. CARE OF TOOLS

1. Wood handles must be free of cracks and splinters and tight in the head
    a. Cracked handles must be replaced
    b. Splinters must be sanded to make handles smooth
    c. All wood handles should be varnished or rubbed with linseed oil
    d. Never paint
        (1) Paint is a good conductor
        (2) Cracks can not be detected
2. Moving parts must be oiled lightly
3. Unpainted parts must be kept free of rust
4. Painted tools must be kept clean and repainted when necessary
5. Chromed tools must be kept free of dirt and finger marks
6. Cutting tools
    a. Must be sharp
    b. Free of nicks
    c. Do not overheat when grinding
    d. Remove keen edge because it will dull quickly

B. MOUNTING AND CARRYING TOOLS AND EQUIPMENT

1. Have a place for each tool
2. Keep it in its place
    a. Can be found quickly
    b. Aids in pick up
3. Use mounting brackets for all tools, do not carry loose
4. Portable pumps, light plants, and etc.
    a. Must be fastened securely
    b. Must be able to be removed quickly and easily

C. STRIKING TOOLS

1. Hammer Head Pick

    SHOW SAMPLE or REFER learners to Fig. 1, p. 147, Fire Service Training (text).

    a. Use hammer head as a sledge
    b. Pick end is used for:
        (1) Freeing iron bars from masonry
        (2) Digging
            (a) Dirt
            (b) Concrete
            (c) Cinders, etc.
2. Sledge Hammer

    SHOW SAMPLE or REFER learners to Fig. 2, p. 147, Fire Service Training (text).

    a. Used to break out concrete
    b. Free iron bars from masonry
    c. Has weight and striking power

Instructor's Notes

3. Rubber or Lead Mallet
   SHOW SAMPLE.
   a. Used to tighten suction hose couplings
4. Battering Ram
   SHOW SAMPLE or REFER learners to Fig. 3, p. 147, Fire Service Training (text).
   a. Used to breach walls
   b. Used to force doors that can not be opened in any other way

D. CUTTING TOOLS

1. Handled Hammer Headed Chisel
   SHOW SAMPLE.
   a. For cutting rivets, bolts, bars, cement, etc.
   b. For splitting heavy planks
2. Hand Hatchet
   SHOW SAMPLE or REFER learners to Fig. 4, p. 147, Fire Service Training (text).
   a. Small one hand tool
   b. Used in confined places for light cutting
3. Pompier Hatchet
   SHOW SAMPLE or REFER learners to Fig. 5, p. 147, Fire Service Training (text).
   a. Small hand tool
   b. Used in confined places
   c. For light cutting
   d. Pick end for light pry
   e. Easy to carry in belt
4. Crash Axe
   SHOW SAMPLE or REFER learners to Fig. 6, p. 147, Fire Service Training (text).
   a. Small one hand tool
   b. Cuts wood, plaster and light metal
5. Metal Roof Cutters
   SHOW SAMPLE or REFER learners to Figs. 7 & 8 , p. 148, Fire Service Training (text).
   a. Used to cut or remove metal roofs
   b. Rotary cutter
   c. Fixed blade
6. Bolt Cutters
   SHOW SAMPLE or REFER learners to Fig. 9, p. 148, Fire Service Training (text).
   a. For cutting bolts and nails
   b. Do not use on electric wires
   c. Do not use on hardened steel
7. Pickhead and Flat Head Axe
   SHOW SAMPLE or REFER learners to Figs. 10 & 11, p. 148, Fire Service Training (text).
   a. Used for cutting
   b. Used for striking
   c. Used for prying

Instructor's Notes

8. Wire Cutters

   SHOW SAMPLE or REFER learners to Figs. 12 & 13, p. 148, Fire Service Training (text).

   a. Used only by qualified personnel
   b. Has insulated handles for cutting charged electric lines

9. Power Chain Saw

   SHOW SAMPLE or REFER learners to Fig. 14, p. 149, Fire Service Training (text).

   a. Powered by gas or electric
   b. Used for cutting, floors, large wood beams, etc.

10. Power Saber Saw

    SHOW SAMPLE or REFER learners to Fig. 15, p. 149, Fire Service Training (text).

    a. Powered by electricity
    b. Used for cutting wood and metal

11. Power or Cut-off Saw

    SHOW SAMPLE or REFER learners to Fig. 16, p. 149, Fire Service Training (text).

    a. Powered by electricity
    b. Used to open floors and cut thin wood

E. HOISTING AND PULLING TOOLS

EXPLAIN that these tools are important.

1. Hose Rollers

   SHOW SAMPLE or REFER learners to Fig. 17, p. 149, Fire Service Training (text).

   a. Used to raise and lower equipment
   b. Can be placed on cornice, window sill, etc.

2. Pull Down Hook

   SHOW SAMPLE or REFER learners to Fig. 18, p. 150, Fire Service Training (text).

   a. Used to pull down unsafe walls and removing obstacles

3. Grappling Hooks

   a. Used for under water recovery of objects and bodies

4. Sheathing Hook

   SHOW SAMPLE or REFER learners to Fig. 19, p. 150, Fire Service Training (text).

   a. Used in confined places to remove plaster, etc.

5. Plaster Hook

   SHOW SAMPLE or REFER learners to Fig. 20, p. 150, Fire Service Training (text).

   a. Has a spear head
   b. Knife like wings
   c. Used to pull ceilings

Instructor's Notes

6. Pike Pole
   SHOW SAMPLE or REFER learners to Fig. 21, p. 150, Fire Service Training (text).
   a. Used to remove ceilings and plaster, etc.

F. PRYING TOOLS

EXPLAIN that they are used for forcible entry and if not properly used excessive damage can result.

1. Claw Tool
   SHOW SAMPLE or REFER learners to Fig. 22, p. 151, Fire Service Training (text).
   a. Used to open doors, windows, and to remove man hole covers
2. Door Openers
   SHOW SAMPLE or REFER learners to Figs. 23 & 24, p. 151, Fire Service Training (text).
   a. For opening doors
3. Crow Bar
   SHOW SAMPLE or REFER learners to Fig. 25, p. 151, Fire Service Training (text).
   a. For heavy prying
4. Buster Bar
   SHOW SAMPLE or REFER learners to Fig. 26, p. 151, Fire Service Training (text).
   a. Has wedged shape tip
   b. Adjustable fulcrum
   c. For light prying jobs
5. Hux Bar
   SHOW SAMPLE or REFER learners to Fig. 27, p. 151, Fire Service Training (text).
   a. Used as a pry
   b. Used for hydrant wrench
   c. Used as a cutter
6. Kelley Tool
   SHOW SAMPLE or REFER learners to Fig. 28, p. 151, Fire Service Training (text).
   a. Can be used as a pry or chisel

G. BORING AND DRILLING TOOLS

1. Wood auger
   SHOW SAMPLE or REFER learners to Fig. 29, p. 152, Fire Service Training (text).
   a. Used on wood floors and roofs, to start saws and draining operations
2. Brace and Bits
   SHOW SAMPLE or REFER learners to Figs. 30, 31, & 32, p. 152, Fire Service Training (text).

a. Can be used on wood and metal

H. CUTTING TORCH

SHOW SAMPLE or REFER learners to Fig. 33, p. 152, Fire Service Training (text).

1. Used for cutting bars and steel doors

I. PORTABLE GENERATORS

SHOW SAMPLE or REFER learners to Fig. 34, p. 153, Fire Service Training (text).

1. Furnish power for lights and power tools
2. Emergency power to hospitals
3. Manufacturers manual should be followed
   Read from this manual the care and maintenance of generator.
4. Carry a supply of extra gas

J. LIGHTS

EXPLAIN that lights are a must in fire fighting operations. It aids men to see what they are doing, so they can do a better, and quicker job and do it safely.

1. Flash Light
   a. Each man should carry one
   b. They can be used for inspection and hand signals
   c. Gives men added safety at night or in dark places
   d. Keep them clean
   e. Extra batteries and bulbs should be available
2. Electric Hand Lantern
   SHOW SAMPLE or REFER learners to Fig. 35, p. 153, Fire Service Training (text).
   a. Are wet or dry type
   b. Are flood or spot
   c. Keep clean
   d. Extra bulbs and batteries should be available
3. Electric Spot Lights and Floodlight
   SHOW SAMPLE or REFER learners to Figs. 36 & 37, pp. 153 & 154, Fire Service Training (text).
   a. Retractable Cable case
   b. Can be plugged in house socket
   c. Can be plugged in truck or portable generator
   d. Keep clean

K. MISCELLANEOUS TOOLS AND EQUIPMENT

EXPLAIN that these tools are also very important.

1. Hose Straps
   SHOW SAMPLE or REFER learners to Figs. 38 & 39, p. 154, Fire Service Training (text).
   a. Used to carry or drag hose
   b. Used to secure hose to ladders, window sills, etc.

Instructor's Notes

c. Used to secure ladder

d. Keep clean and replace worn straps

2. Rope Hose Tool

   SHOW SAMPLE or REFER learners to Figs. 40 & 41, p. 155, Fire Service Training (text).

   a. Used as a life belt on ladder

   b. Used for rescue carries

   c. Used as hose strap

   d. Used to tie ladder in

3. Gas and Water Key

   SHOW SAMPLE or REFER learners to Fig. 42, p. 155, Fire Service Training (text).

   a. Used to turn off gas and water at curb box

   b. EXPLAIN the difference in construction of a gas and a water key

4. Spanner Wrench and Holder

   SHOW SAMPLE or REFER learners to Fig. 43, p. 155, Fire Service Training (text).

   a. Used to loosen or tighten hose couplings

   b. Used to shut off gas meters

   c. Used as a light pry and hammer

   d. Should be placed in holders after use

5. Hydrant Wrench

   a. Used to remove tight caps and turn on hydrants

6. Smoke Ejector

   SHOW SAMPLE or REFER learners to Fig. 44, p. 156, Fire Service Training (text).

   a. Used in ventilation and should have a sealed or safety motor for power

7. Voice Power Megaphone

   SHOW SAMPLE or REFER learners to Fig. 45, p. 156, Fire Service Training (text).

   a. Used at fires and training areas for giving orders

8. Camera

   SHOW SAMPLE or REFER learners to Fig. 46, p. 156, Fire Service Training (text).

   a. Can be used for inspections, arson detection, post mortem, and etc.

   b. Extra film and flash bulbs should be available

9. Walkie-talkie Radio

   SHOW SAMPLE or REFER learners to Figs. 47 & 48, p. 157, Fire Service Training (text).

   a. It saves time and energy at fires

   b. It eliminates errors in giving and receiving orders

10. Hose Expanders

    SHOW SAMPLES or REFER learners to Figs. 49 & 50, pp. 157 & 158, Fire Service Training (text).

Instructor's Notes

- a. Hydraulic type
- b. Hand type
- c. Used to reset hose couplings
  - (1) Saves money
  - (2) Shortens length of time hose is out of service

11. Hydrant Pump

    SHOW SAMPLE or REFER learners to Fig. 51, p. 158, Fire Service Training (text).

    - a. Used to remove water from barrel to prevent freezing in cold weather

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 9 in the Learner's Workbook.

STEP IV - CHECKING AND FOLLOW UP:

Review Assignment Sheet No. 9, re-teach any portion of the lesson not thoroughly understood.

TEACHING GUIDE #10

ROPE IN THE FIRE SERVICE

OBJECTIVES:

1. To acquaint the learner with the facts relative to the construction and care of rope.
2. To develop in each learner the ability to tie knots and hitches that are commonly used in the fire service.
3. To have the learner acquire the ability to coil rope.
4. To have each learner understand the use of rope relative to hoisting hose, ladders and minor equipment.

TEACHING AIDS:

1. Chalkboard, chalk and eraser; or chart pad
2. Samples of rope of different materials
3. Ropes of proper sizes and lengths for tying knots (6 feet of sash cord appropriate - each learner to have a rope).
4. Rope long enough to make a coil and for hoisting practice.
5. Rogers rope hose tool.

REFERENCE:

Fire Service Training (text), Chapter 10, pp. 159-173.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Rope is one of the very important necessities of the fire service. It is used extensively in rescue work and for the self-preservation of firemen.

Most extension ladders are equipped with rope to help raise the fly ladder and many special ladder raises require rope for their operation.

Speed is essential for efficient fire fighting and the use of rope in many instances saves precious time. For example, the use of rope in the hoisting of hose lines and small appliances from street level to upper stories or roofs, enable firemen to act quickly and bring about extinguishment; it also saves many steps up and down ladders.

Instructor's Notes

The members of each fire department should be able to tie the various knots required for each operation in the fire service. The knot used by a fireman must be a knot that is easy to tie, will hold securely, and can be untied quickly by another member.

STEP II - PRESENTING THE LESSON:

A. ROPE
  1. Construction of Rope
    a. Manila - *SHOW SAMPLE*
      (1) Comes from abaca plant or wild banana plant in the Phillipine Islands
      (2) Considered the best for fire department use and the strongest of the natural fiber ropes
    b. Sisal - *SHOW SAMPLE*
      (1) Comes from henequin plant grown in Yucatan, Dutch East Indies and Africa
      (2) Is only 75% as strong as manila fiber
    c. Hemp - *SHOW SAMPLE*
      (1) Comes from hemp plant which grows mostly in Italy, Russia and the United States
    d. Nylon - *SHOW SAMPLE*
      (1) Comes from synthetic fibers
      (2) Tensile strength is two to three times greater than manila rope

Place the following comparison on chalkboard

TENSILE STRENGTH COMPARISON

#1 grade-3 strand manila rope	3 strand nylon rope
1/4" - 600 lbs.	1/4" - 1,800 lbs.
1/2" - 2,650 lbs.	1/2" - 6,900 lbs.
3/4" - 5,400 lbs.	3/4" - 15,000 lbs.

      (3) Has a service life 4 times greater than manila rope
      (4) Weighs 40% less than manila rope
      (5) Considered good for aerial ladder rescue operation when using rescue basket
      (6) Because of slick finish, does not present as much friction as manila rope and for this reason knots are more likely to become untied
    e. Rope is constructed by

DEMONSTRATE from samples of rope how construction is achieved.

Instructor's Notes

- (1) Twisting fibers together to make a yarn
- (2) Yarns are twisted together to make a strand
- (3) Strands are twisted together to make a rope
- (4) Reversing twist in every step in building up a rope locks it together
- (5) Twist in one direction offers an equal resistance to twist in opposite direction
- (6) Direction of twist is indicated by terms "left hand" and "right hand" or "with the sun"

f. EXPLAIN reasons for stretching and how new rope should be stretched

REFER learners to Fig. 1, p. 159, Fire Service Training (text) and EXPLAIN.

2. Types of Rope
   - a. Three strands laid up in a "right hand" direction form a hawser-laid rope
     - (1) Most rope used in the fire service is hawser laid

       REFER learners to Fig. 3, p. 160, Fire Service Training (text).
   - b. Four strands laid up in a "right hand" direction and having a central core will form a shroud-laid rope
     - (1) Principally used for power transmission

       REFER learners to Fig. 4, p. 160, Fire Service Training (text).
   - c. Three hawser-laid ropes laid up in a "left hand" direction form a cable laid rope
     - (1) Used in well drilling and mining
3. Size and Weight of Rope
   - a. Size measured by giving its diameter in inches
   - b. Sold by weight or pounds

     REFER learners to Fig. 5, p. 161, Fire Service Training (text), on weight of 100 feet of manila rope in various sizes.
4. Strength of Rope
   - a. In choosing a rope for a given purpose, a large margin of safety should be used
   - b. Breaking strength should be about seven times the load to be lifted (calculated in pounds)

     REFER to Fig. 5, for safe load pounds and breaking load pounds.
   - c. Liberal allowance should be made when estimating the strength of old rope
5. Inspection of Rope
   - a. Rope should be checked after each use and at least every six months if not used
   - b. Examination should determine condition of rope through its entire length

Instructor's Notes

c. Exterior inspection
DEMONSTRATE proper method.
  (1) Abrasion (broken fibers)
  (2) Cuts
  (3) Extremely soft
  (4) Decayed or burned by high temperature or chemicals

d. Inside inspection
DEMONSTRATE proper method.
  (1) Separate strands at three foot intervals
  (2) Examine for:
    (a) Broken fibers
    (b) Fine powder indicates presence of grit
    (c) Mildew or mold
    (d) Change in color of fibers

e. Rope when stored should not be:
  (1) Exposed to dampness or sharp edged tools
  (2) Should always be coiled and ready for use

6. Use of Rope

a. Sizes
  (1) Because of importance, rope should be carried on all apparatus
  (2) Should vary in size and number depending upon department requirements
  (3) Sizes needed vary from 1/4 inch to 1 inch in diameter and in length of 100 to 150 feet

b. Uses
  (1) To operate the fly ladder on extension ladders
  (2) To hoist ladders, tools and appliances
  (3) As a life line in mask and rescue work
  (4) To aid in maintaining fire lines
  (5) To lash ladders together to extend their length
  (6) Roping off dangerous areas
  (7) For wrecking operations
  (8) As guy lines when hoisting equipment
  (9) As a permanently attached hoisting line on aerial ladder

A belt equipped with a small hand axe, a spanner wrench and 100' of 1/2" rope is a useful piece of equipment for firemen to take along when necessary to work from upper stories or roofs. Rope can be used to hoist small hose line, and etc.

B. KNOTS, BENDS AND HITCHES
EXPLAIN the following:

1. A knot is a knob formed in a piece of rope by inter-weaving its strands

Instructor's Notes

2. A bend is a method of fastening one rope to another or to a ring, loop, etc.
3. A hitch is a temporary knot or noose by which a rope is fastened around a timber, post, etc., so as to be readily untied
4. Most knots ordinarily used, strictly speaking, are bends
5. Knots stay tied due to frictional resistance of the rope
6. Usefulness of a knot should be judged by:
   - a. Rapidity by which it can be tied
   - b. Ability to hold fast when pulled tight
   - c. Ease by which it can be untied
7. Effect of knots, bends and hitches on the strength of rope
   - a. Rope has maximum strength when strain is applied evenly to all fibers
   - b. When rope is tied, weakest part of rope is at the knot
   - c. The shorter the bend, the less tensile strength of the rope
   - d. Decrease in tensile strength when using knots are:

Place following on chalkboard.

Square Knot	- 50%	Becket Bend	- 50%
Bowline	- 40%	Clove Hitch	- 35%
Short Splice	- 20%	Running Bowline	- 35%

8. Knots and hitches that firemen need to know

Those listed on p. 163-165, Fire Service Training (text).

Rails of a straight ladder provide an excellent means for the practice of knot tying. Place heel end and top end of ladder on some object. Elevation should be about waist high. Learners should be positioned on each side of the ladder.

Emphasis should be placed on tying the clove hitch, half-hitch and bowline, they are used 95% of the time for hoisting, and etc. If firemen can master these three knots, they will be effective most of the time. Of course, all knots should be practiced.

- a. Half-hitch

  DEMONSTRATE how to tie half-hitch and have learners tie hitch with practice rope around an object.

  - (1) Used either alone or in combination with other knots
  - (2) Free end of rope brought around tension end and then brought under itself

- b. Square knot

  DEMONSTRATE how to tie square knot and have learners tie knot with practice rope. Check learners to be sure knot is tied properly.

  - (1) Used in tying bandages in first aid and tying together two ropes of same size
  - (2) Will not slip - draws tight and is easily untied

Instructor's Notes

c. Clove hitch

DEMONSTRATE the two methods in tying clove hitch and have learners tie knot with practice rope around an object. Check learners to be sure knot is tied properly.

(1) Used for hoisting or lowering small equipment. Also to fasten a rope to a stake, pipe or post
(2) Can be tied by two methods

d. Bowline

DEMONSTRATE how to tie the bowline and have learners tie knot with practice rope around an object. Check learners to be sure knot is tied properly.

(1) Used whenever loop is desired in end of rope
(2) Never slips and is easily untied
(3) Used for raising and lowering ladders
(4) When used as a life line
  (a) Place rope around man's chest just under his arms and tie bowline
  (b) Position of knot should be between shoulder blades

e. Bowline on a bight

DEMONSTRATE how to tie bowline on a bight and have learners tie knot with practice rope around some object. Check learners to be sure knot is tied properly.

(1) Made by forming a loop at some point in a rope other than at the end
  (a) Easily untied
  (b) Used in rescue work, also to form a saddle for lowering men in manholes and similar places

f. Chimney hitch

DEMONSTRATE how to tie chimney hitch and have learners tie knot with practice rope around a pole or ladder beam. Check learners to be sure knot is tied properly.

(1) Used to secure a tight line, to secure hose, hose roller or similar object
(2) Knot can be slipped along main rope to take in or let out slack and will hold its position where-ever set

g. Sheep shank

DEMONSTRATE how to tie the sheepshank and have learners tie knot with practice rope. Check learners to be sure knot is tied properly.

(1) Used as a temporary measure to shorten or strengthen a rope

h. Becket knot

DEMONSTRATE how to tie a becket knot and have learners tie knot with practice rope. Check learners to be sure knot is tied properly.

Instructor's Notes

(1) Used to fasten two ropes of different sizes together

i. Running bowline

DEMONSTRATE how to tie the running bowline and have learners tie knot with practice rope. Check learners to be sure knot is tied properly.

(1) Used to take the strain off couplings on hose when hoisting up the side of a building

(2) May be used whenever a slip knot is needed

C. ROPE SPLICING

If class schedule permits

1. STATE that the principal steps in splicing a rope are:
   a. Unlaying the strands
   b. Placing the ends together
   c. Tucking the ends of the strands

2. The Short Splice

   DEMONSTRATE to learners the proper method to follow in making the short splice. REFER learners to Fig. 21, p. 167, Fire Service Training (text).

   a. Used where it is not necessary for a rope to pass through a small pulley
   b. Where only a small amount of rope cane be spared for making a splice
   c. Considered as strong as the long splice

3. The Long Splice

   EXPLAIN to learners the proper method to follow in making the long splice. REFER learners to Fig. 22, p. 168, Fire Service Training (text).

   a. Used where necessary for rope to pass through small pulleys
   b. Has neater appearance than short splice

4. The Spliced Crown

   EXPLAIN to learners the proper method to follow in making the spliced crown. REFER learners to Fig. 23, p. 169, Fire Service Training (text).

   a. Used to finish end of rope
   b. Can be used to good advantage where a slight enlargement is not objectionable at end of rope

D. ROPE COILS

1. STATE that it is essential to have rope properly coiled and ready for immediate use in order to render efficient service

   DEMONSTRATE method of coiling rope and impress upon group the importance of each department having a rope coiler. REFER learners to Figs. 24-30, pp. 169-170, Fire Service Training (text).

Instructor's Notes

2. Benefits derived from having rope coiled properly:
   a. Neatness
   b. Ease in carrying
   c. Speed in using
   d. Prevents snarls
3. Coil for throwing rope:
   a. Necessary to throw rope to a roof
   b. Cannot be done unless rope is properly coiled for throwing
   c. Practice necessary to throw correctly
   d. Must be able to judge right amount of rope in each coil for distance

   ***DEMONSTRATE** method to follow to make coil for throwing rope.*
   ***REFER** learners to Fig. 31, p. 171. Fire Service Training (text).*

E. ILLUSTRATIONS OF KNOTS AND HITCHES

1. Practical uses of knots

   ***DEMONSTRATE** and have learners practice.*
2. Methods and knots used to hoist hose and minor appliances

   ***REFER** learners to Figs. 32-38, pp. 171-173, Fire Service Training (text).*
   a. Never hoist a charged line unless absolutely necessary
   b. By substituting a clove hitch for a bowline, this tie can be used to lower an uncharged hose line
   c. Bowline tie for hoisting a ladder

      ***REFER** learners to Fig. 39, p. 173, Fire Service Training (text).*
   d. Alternate tie for hoisting a ladder
      (1) Place ladder on beam
      (2) Start at top of ladder and thread rope between first and second rungs of the ladder
      (3) Skip two or three rungs and continue threading
      (4) Finish by bringing rope between last two rungs and tie a clove hitch around one of the beams below the bottom rung
      (5) When ladder is being hoisted, rope should be on the inside of the top rung going up (building-side) and on the outside when being lowered
3. Rescue Tie
   a. Used for raising or lowering a trapped person

      ***REFER** learners to Fig. 40, p. 173, Fire Service Training (text).*

F. ROGERS ROPE HOSE TOOL

Have learners refer to Figs. 40-41, p. 155; Fire Service Training (text).
***SHOW A SAMPLE.** Follow explanation in the manual, p. 154.*

Instructor's Notes

STEP III - APPLICATION

Have learners work Assignment Sheet No. 10 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP

REVIEW Assignment Sheet No. 10, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #11

LADDERS

OBJECTIVES:

1. To convey to the learner the importance of ladders in conjunction with successful fire fighting and rescue operations.
2. To study the types, design and materials used in the construction of all ladders in the department.
3. To learn the technique of inspecting and testing ladders.
4. To develop the skill of carrying, raising and climbing the various ladders used in the department.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Model of trussed ladder, if available
3. Model of solid beam ladder, if available
4. Straight ladders of various lengths
5. Extension ladders
6. Bangor ladder, equipped with tormentor poles, if available
7. Two 100 foot coils of 1/2" or larger rope
8. Rogers rope hose tool
9. Roof ladder

REFERENCE:

Fire Service Training (text), Chapter 11, pp. 174-200.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

A ladder used in the fire service is an appliance made of wood or metal consisting of two side pieces between which a series of bars or rungs are set at suitable distances. Ladders provide a means of enabling firemen to ascend or descend from one level to another.

When permanent means, such as stairways and fire escapes, are not available firemen must use ladders when ascending or descending from one level to another in order to extinguish fires or rescue occupants of a building. Therefore, it is essential that all firemen know how to carry, raise and climb ladders efficiently. These operations should be practiced until they become as nearly automatic as possible.

STEP II - PRESENTING THE LESSON:

Instructor's Notes

A. DESIGN, CARE, AND INSPECTION

1. Ladder Design
    a. Solid beam

    REFER learners to Fig. 1, p. 174, Fire Service Training (text).

    b. Trussed beam

    REFER learners to Fig. 2, p. 175, Fire Service Training (text).

        (1) Purpose of trussed beams are to make them stronger and decrease weight

        SHOW model ladders and EXPLAIN difference between solid and trussed beam. If not available, use book illustrations or draw on chalkboard.

2. Ladder Terminology
    a. Extension ladder - ladder built in two or more sections
    b. Straight ladder - ladder of one section
    c. Bangor ladder - extension ladder with poles
    d. Main or bed ladder - lowest section of extension ladder
    e. Fly ladder - upper section of extension ladder
    f. Heel-foot or butt - the bottom or ground end of ladder
    g. Top or tip - the top of ladder
    h. Beam - principle structural members of ladder in which rungs are supported
    i. Truss - tension member of beam-running parallel to main beam
    j. Rungs - cross members, between beams used in climbing
    k. Tormentors - poles attached to upper end of beam of main ladder used to raise, guide and steady ladder
    l. Spurs - metal devices at butt of ladder and poles
    m. Halyard or fly rope - rope used in hoisting fly ladder
    n. Pulleys - small grooved wheel through which rope is drawn
    o. Pawl or lock - lock used to support fly ladder after raised
    p. Truss blocks - wooden blocks placed between beams and truss members of trussed ladder
    q. Braces - wooden braces running diagonally from beams to trusses between blocks of truss ladder
    r. Stops - wooden or metal blocks which prevent fly ladder from extending out of main ladder
    s. Guides - light wood or metal strips on extension ladder which guides fly ladder while it is being raised
    t. Tie rods - metal rods which hold ladder assembly together
    u. Beam bolts - bolts passing through beams to prevent splitting

Instructor's Notes

3. Types of Ladders
   a. Straight ladder
      (1) May be solid or trussed
      (2) Generally range from 10 to 30 feet in length
      (3) 10 foot length are usually roof type
   b. Extension ladder
      REFER learners to Fig. 3, p. 176, Fire Service Training (text).
      (1) May be solid or trussed
      (2) Consists of two or more sections
      (3) Fly ladder slides through guides on upper end of bed ladder
      (4) Fly ladder equipped with dogs on lower end that hook over rungs of bed ladder, when extended to desired height
      (5) Fly is raised with rope fastened to lower rung and operates with pulley on upper end of bed ladder
      (6) Generally from 12 feet in length on service ladders to 100 feet in length on aerial ladders
      (7) Extension ladders of 35 feet or longer are generally equipped with tormentor poles
          REFER learners to Fig. 4, p. 176, Fire Service Training (text).
   c. Roof ladder
      REFER learners to Fig. 5, p. 177, Fire Service Training (text).
      (1) May be solid or trussed
      (2) Generally from 10 to 16 feet in length (Some may be up to 24 feet in length)
      (3) Generally built with hooks mounted on a movable socket which permits them to fold inward when not in use
      (4) May be used to get to peaks of gabled roofs, also in entering scuttle holes, holes cut through flooring and side walk openings
   d. Attic or folding ladder
      REFER learners to Fig. 6, p. 177, Fire Service Training (text).
      (1) Generally not over 10 feet in length
      (2) Can be carried and put in use where other ladders would be cumbersome
      (3) To operate, place ladder in vertical position, grasp each of beams, pulling them apart
      (4) Very useful in entering attics and other places where space is limited
   e. Aerial ladder
      REFER learners to Fig. 7, p. 177, Fire Service Training (text).
      (1) Mechanically operated
      (2) Made of from 2 to 4 sections according to length

Instructor's Notes

(3) Used in rescue and controlling fire in areas that would be inaccessible by any other method
(4) Several different types manufactured
(5) Refer to manufacturers manual for operating procedure and maintenance

4. Materials Used and Specifications Required in Construction
   a. Since the lives of firemen and many others are dependent on the use of ladders, only the best of materials are used
   b. Any ladder that becomes deformed by heat, or damaged or have been overloaded should be discarded
   c. Ordinary commercial ladders, such as painters and construction workers use should not be adapted to the fire service
   d. The following specifications should be met when new ladders are purchased:
      (1) Beams - Douglas fir or Navy specification airplaine spruce
      (2) Rungs - second growth hickory or ash
      (3) Cross or brace rods - steel and bolted - spacing not to exceed 5 feet
      (4) Hardware - rust resisting material or thoroughly plated or painted
      (5) Heel irons or spurs - double nibs extending 3/4 inch
      (6) Hooks - collapsible hooks of roof ladders should be of ample strength and sturdy construction
         (a) Hooks should be placed so that beam ends will protrude as far as the rounded part of the hooks
         (b) Hooks should be firmly fastened to end of rails
      (7) Locks, dogs, latches - sturdy construction and positive in action
      (8) Pulleys - plated steel, bronze, or equivalent metal, self-lubricating and with ample rope groove
      (9) Ropes - good grade of manila, not less than 3/8 inch
      (10) Finish
         (a) Top 18 inches of beams and top rung to be painted some distinctive color, such as white, to aid visibility in smoke and darkness
         (b) Bottom of ladder painted black
         (c) Working length painted with numerals at least 1-1/2 inches high

Instructor's Notes

- (d) All other parts of ladder to be varnished

5. Mounting Brackets and Nesting
    - a. Should hold ladder rigid while in transit
    - b. When two ladders are carried together on side of truck
        - (1) Mounting should be such that outside ladder can be taken off separately and easily
    - c. When carried on apparatus
        - (1) Width and length of roof ladders should be such as to permit nesting inside the fly of an extension ladder
6. Tests and Loading
    - a. When set at the proper climbing angle
    - b. Each ladder should be capable of withstanding the following test:
        - (1) Dead weight or load of one man's weight every 5 feet
        - (2) A live or moving load of 200 pounds every 10 feet
        - (3) Each rung to stand a dead weight at center of 400 lbs.
7. Inspection of Ladders - Wood
    - a. STATE that rigid inspection of ladders after use and at regular intervals is an important function
        - (1) If not strictly followed, many accidents may occur and injuries result from lack of inspection
    - b. Items to check in the inspection of ladders:
        - (1) Rungs
            - (a) Looseness
            - (b) Wear
            - (c) Slivers
            - (d) Checks
            - (e) Dry rot
            - (f) Need of varnish
        - (2) Beams
            - (a) Slivers
            - (b) Checks or cracks
            - (c) Dry rot
            - (d) Protective varnish
            - (e) Warping
        - (3) Butts
            - (a) Defects of metal parts
            - (b) Dullness of butt
        - (4) Ropes
            - (a) Dry rot

Instructor's Notes

- (b) Weakness
- (c) Wear
- (5) Locks and pulleys
  - (a) Breakage
  - (b) Wear
  - (c) Lubrication
  - (d) Springs, if any
- (6) Tie bolts and beam bolts
  - (a) Tightness
  - (b) Burrs or sharp edges
- (7) Snap ropes
  - (a) Defects

c. Items to consider when overhauling wood ladders:

- (1) Revarnish all worn places
- (2) Replace halyard rope
- (3) Tighten all truss rods, tie rods and beam bolts
  - (a) May require special wrench
- (4) Test ladder for strength
  - (a) Method to use

8. Inspection of Ladders - Metal

a. Items to check:

- (1) Rungs
  - (a) Welds
  - (b) Damage or weakness caused by improper lowering against building
- (2) Beams
  - (a) Welds
  - (b) Signs of excessive strain
  - (c) Deformed from heat or overload
- (3) Ropes
  - (a) Dry rot
  - (b) Weakness
  - (c) Wear
- (4) Locks and pulleys (Same as for wood)

b. Items to consider when overhauling metal ladders:

- (1) Normally, metal ladders should be returned to manufacturer for overhauling
- (2) Replace halyard ropes
- (3) Test ladder for strength

c. PRECAUTIONS - do not allow metal ladders and electric wires to come in contact

B. LADDER CARRIES

***Note:** This part of the lesson should be taught by conducting Outdoor Evolutions.*

LADDERS

Instructor's Notes

1. Cooperation and Rythmn Necessary
    - a. Handling ladders requires extensive practice
    - b. Handling ladders requires cooperative procedures and training
        - (1) The men must work in unison with each other

Adjust ladder carries and raises to the equipment of the department being trained. Include in this practicing of evolutions the re-placing of the ladder in their proper places on the apparatus.

2. Carries
    - a. EXPLAIN, DEMONSTRATE and PRACTICE - One man carry
        - (1) When used
        - (2) Method of doing
        - (3) Precautions
    - b. EXPLAIN, DEMONSTRATE and PRACTICE - Two man carry
        - (1) When used
        - (2) Method of doing
            - (a) When taking ladder off apparatus
            - (b) When ladder is on ground
    - c. EXPLAIN, DEMONSTRATE and PRACTICE - Four man carry
        - (1) Method of doing
            - (a) When taking ladder off apparatus
            - (b) When ladder is flat on ground
        - (2) How to carry through narrow passageway
        - (3) How to reverse direction
        - (4) Precautions
    - d. EXPLAIN, DEMONSTRATE and PRACTICE - Six man carry
        - (1) Where used
        - (2) Method of doing
            - (a) When taking ladder off apparatus
            - (b) When ladder is flat on ground
            - (c) How to reverse direction
        - (3) Precautions
    - e. EXPLAIN, DEMONSTRATE and PRACTICE - Vertical carry
        - (1) Where, why and when used
        - (2) Method of doing
        - (3) Precautions

C. LADDER RAISES

Note: This part of the lesson should be taught by conducting Outdoor Evolutions.

1. The same system of working in unison with one another, as practiced in ladder carries, is very essential in ladder raises

Instructor's Notes

a. Some raises can be combined with corresponding carries to make one evolution
    (1) In such cases, only the heel man lowers his end of the ladder
        (a) The other man or men rapidly elevate the ladder from their halted position

2. EXPLAIN, DEMONSTRATE and PRACTICE - Placing ladders
    a. Several methods to determine distance of ladder heels from the building
    b. The method generally applied is one-fourth of the length of the ladder
    c. Proper placing of ladders in windows and on roofs
3. EXPLAIN, DEMONSTRATE and PRACTICE - Types of raises
    a. One man flat raise - straight ladder
    b. Two man beam raise - straight ladder
    c. Raise ladder at angle to building
    d. Three man flat raise - straight ladder
    e. Raising extension ladder - two man-beam raise
    f. Raising extension ladder - three man flat raise
        (1) Method of raising
        (2) Method of lowering
        (3) Precautions
    g. Raising ladder under overhead obstructions
        (1) When, why and where used
        (2) Method used
        (3) Precautions

D. POLE OR BANGOR LADDER TECHNIQUES AND PRACTICES

1. EXPLAIN, DEMONSTRATE and PRACTICE - Pole or Bangor ladder raise

    See suggestions for each of the following, pp. 187-191, Fire Service Training (text).

    a. Suggestions for the pole men
    b. Suggestions for the heel men
    c. Suggestions for raising the fly
    d. Raising Bangor ladder with six men

    REFER learners to Figs. 26 & 27, pp. 188-189, Fire Service Training (text).

    e. Raising Bangor ladder with four men

    REFER learners to Figs. 28, 29, & 30, pp. 189-190, Fire Service Training (text).

    f. Raising Bangor ladder - parallel to building

    REFER learners to Figs. 31 thru 34, pp. 190-191, Fire Service Training (text).

        (1) Method of raising
        (2) Method of lowering
        (3) Precautions

Instructor's Notes

g. Raising Bangor ladder - beam raise
REFER learners to Fig. 35, p. 191, Fire Service Training (text).
(1) Where used - narrow spaces, behind wires, etc.
(2) Method of raising
(3) Method of lowering
(4) Precautions

E. CLIMBING PROCEDURE, SPECIAL USES AND SPECIAL LADDER EVOLUTIONS

REFER to description of the following in the text. Usually outdoor evolutions.

1. EXPLAIN, DEMONSTRATE and PRACTICE - Climbing procedure
   a. Why good form in climbing is essential
   b. How accomplished
   c. Precautions
2. EXPLAIN, DEMONSTRATE and PRACTICE - Special Uses and Practices
   a. Making a step ladder
      (1) When, why and where used
      (2) How made
      (3) Precautions
   b. High ceiling, church or flagpole raise
   REFER learners to Figs. 38 & 39, pp. 192-193, Fire Service Training (text).
      (1) When, where and why used
      (2) Method of doing
      (3) Precautions
   c. Leg Lock
   REFER learners to Figs. 40-42, pp. 193-194, Fire Service Training (text).
      (1) Why, when and where leg lock can be used to a good advantage
      (2) Show proper method to follow
   d. End to end splice
   REFER learners to Fig. 43, p. 194, Fire Service Training (text).
      (1) When, where and why used
      (2) Methods of doing
      (3) Precautions
   e. Hotel or factory raise
   REFER learners to Fig. 44, p. 195, Fire Service Training (text).
      (1) When, where and why used
      (2) Method of doing
      (3) Precautions
   f. Placing roof ladder in service - two methods
   REFER learners to Fig. 45, p. 196, Fire Service Training (text).
      (1) When, where and how each method is used
      (2) Precautions

Instructor's Notes

g. Ladder bridging – various conditions
   (1) Ladder to window
       REFER learners to Fig. 46, p. 196, Fire Service Training (text).
   (2) Roof to roof or window
       REFER learners to Fig. 47, p. 197, Fire Service Training (text).
   (3) Pivot or swing around bridge
       REFER learners to Fig. 48, p. 197, Fire Service Training (text).

h. Anchoring ladders
   REFER learners to Fig. 49, p. 197, Fire Service Training (text).
   (1) When it is necessary to anchor ladder
   (2) Why done
   (3) How accomplished

3. EXPLAIN, DEMONSTRATE and PRACTICE – Holds and Evolutions Used in Ladder Climbing
   a. Backing up a man on a ladder
      REFER learners to Fig. 50, p. 198, Fire Service Training (text).
      (1) Show proper method
      (2) Precautions
   b. Crotch hold – two methods
      REFER learners to Fig. 50, p. 198, Fire Service Training (text).
      (1) Why, when and where crotch hold can be used to a good advantage
      (2) Show proper method to follow
      (3) Precautions

4. Safe Practices and Procedures in Care and Use of Ladders
   EXPLAIN and DISCUSS items 1 through 20 on pp. 198-200, Fire Service Training (text).

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 11 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 11, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #12

GAS MASKS

OBJECTIVES:

1. To emphasize the importance and necessity for using gas masks to protect firemen from the poisonous and toxic atmospheres which exist or develop during emergency operations.
2. To acquaint the learner with the characteristics of common gases encountered at the scene of an emergency.
3. To familiarize the learner with the various types, operation, limitations, uses and care of respiratory equipment.
4. To emphasize methods and needs for training in this area.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. The types of masks used by the department
3. Other types of masks not used by the department
4. Smoke chamber and materials for creating smoke (smoke bombs or combustibles)
5. Various cutting tools and materials to be used during smoke drills.

REFERENCE:

Fire Service Training (text), Chapter 12, pp. 201-218.

Instructor's Notes STEP I - INTRODUCING THE LESSON:

Although a gas mask is only one of the many pieces of equipment carried on fire apparatus, it is considered to be one of the most important. Because of the potential hazards from chemicals, plastics, refrigerants, synthetic materials and compounds, it is extremely important and necessary to protect firemen who, in an emergency, must operate in atmospheres containing poisonous and toxic gases. There is no reason why the life of any fireman should be jeopardized when rescuing people, or when working in contaminated areas, because equipment to protect his respiratory system was not available, or he was not properly trained in its use. The State of Ohio has afforded the fireman such protection by law.

READ - Section 505.48 Revised Code, Parts A and B, p. 201, Fire Service Training (text).

Continuous training and practice in the use of this equipment is a necessity.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. IMPORTANCE TO FIRE SERVICE

1. The life safety of firemen should be a responsibility of the officers
    - a. By training
    - b. When to use
2. Fundamental rule should be that no one, unless equipped with proper mask, be allowed in fire involved area
3. Protection from radioactive materials
    - a. Should be worn from time of arrival at scene until hazard no longer exists
    - b. Preference for self-contained unit
4. Suggest survey of industrial and commercial areas
    - a. Hazardous gas locations
    - b. Cooperation with staff chemists and engineers
    - c. Good public relations
5. Awareness of explosive as well as poisonous properties of gases, and precautions to be taken

    ***REFER** learners to Fig. 1, p. 202, Fire Service Training (text) and **DISCUSS**.*

    - a. Sparks
    - b. Light switches
    - c. Use of ferrous tools and equipment

B. TYPES AND USES OF GAS MASKS

1. In general, respiratory protective equipment is classified as follows:
    - a. Filter type
    - b. Air or oxygen supplied from outside source
    - c. Self-contained
2. In some instances, respiratory protection alone is not enough
    - a. Some gases may harm body on contact
    - b. In this case, it is necessary to wear protective clothing in addition to respiratory protection
3. Filter Type Canister Masks
    - a. Several different types manufactured
    - b. Protect against some kinds of smoke and poisonous gases and carbon monoxide
    - c. Have definite limitations -
        - (1) Atmosphere must have over 16% oxygen
            - (a) Check with flame on safety lamp
        - (2) Not effective when atmosphere contains over 2% by volume of poisonous gases

Instructor's Notes

(3) Heavy bodied smoke such as from burning plastics impairs operation by clogging intake and interior of cannister

d. Major parts of mask are -
   (1) Cannister with harness and carrying case
   (2) Facepiece with headbands and flexible tubing
   (3) Timer - (Mechanical or Window Indicator Type)
   ***REFER** learners to Fig. 2, p. 203, Fire Service Training (text).*

e. Cannister (Plain Type)
   (1) Painted red
   (2) Other colors for specific gases
   (3) Approved for 2 hours in atmospheres containing carbon monoxide
   (4) Becomes warm when carbon monoxide is present
   (5) Degree of warmth depends on concentration of gas
   (6) Heat is formed as carbon monoxide is changed to carbon dioxide by catalyst
   (7) Stored in cool dry place
   (8) Seals should not be removed until placed into service
   (9) In-service cannisters should be replaced once a year, if the seal has been removed, even though never used
   (10) Always remove seals when ready for use
   (11) Test by inhaling and exhaling
      (a) Inhale only through top opening
      (b) Exhale only through bottom opening
      (c) Audible click will indicate opening and closing of valves
   (12) Drying agents protect catalyst (hopcalite) from normal water vapor during two hour use
   (13) Extreme conditions under which cannister may be ineffective against two hour normal water vapor absorption
      (a) Relative humidity over 85%
      (b) Extended periods of heavy breathing (over 25 liters per minute)
      (c) Air saturated by "fog" or "wet water"
      (d) Accidental introduction of water into cannister by - fire hose, crawling through water on floor, failure to thoroughly dry parts while assembling, and failure to replace seals after use

f. Cannister (Window Indicator Type)
   (1) Painted red

Instructor's Notes

(2) Other colors for specific gases
(3) Approved for two hours in atmospheres containing carbon monoxide, unless subjected to excessive moisture
(4) Becomes warm when carbon monoxide is present
(5) Degree of warmth depends on concentration of gas
(6) Heat is formed as carbon monoxide is changed to carbon dioxide by catalyst
(7) Indicator reference - round glass window with two half circles

Place on blackboard and explain operation of Indicator Reference as shown in Fig. 3, p. 204, Fire Service Training (text).

(a) Right half (facing cannister) is stamped "R" (reference) and is very light blue
(b) Left half is darker blue
(c) When left half matches the right half (R) the cannister is to be discarded, as it will not effectively oxidize carbon monoxide to carbon dioxide, or when excessive moisture has penetrated hopcalite to make it inaffective against carbon monoxide

g. Facepiece
(1) Always clean after using
(2) Sterilize with germicidal solution
(3) Maintain headbands in good working order
(4) Replace torn and defective bands
(5) Defective facepiece should not be used
(6) Conformity to face is dependent upon adjustment of headbands
(7) Examine flexible tubing for cuts or breaks
(a) Defect my jeopardize safety and protection of wearer

h. Timer (used on plain cannister)
(1) Indicates approximate time of safe use
(2) Actuated by respirations of wearer
(3) Pointer on dial makes complete revolution in approximately two hours of continuous or intermittent use
(4) After one complete revolution of pointer on dial, cannister must be replaced

i. Check valve (Used on Window Indicator Cannister)
(1) Fits into assembly formerly occupied by timer
(2) Threaded top and bottom for attachment to cannister and breathing tube

Instructor's Notes

(3) The check valve in assembly closes automatically after each inhalation
(4) Check valve remains closed, regardless of position of cannister and provides seal against moisture entering from top
(5) Check valve assembly eliminates replacement of of rubber stopper

j. Putting on filter type cannister mask

DEMONSTRATE putting on mask in accordance with instructions on p. 205, Fire Service Training (text). Have learners PRACTICE same procedure, making corrections as needed.

k. Precautions and Practices

REFER learners to the six items on pp. 205-206, Fire Service Training (text). READ and DISCUSS each item therein.

5. Fresh Air or Hose Masks

a. Advantages:
(1) Suitable protection against all atmospherical contaminants
(2) Sufficient supply of clean air is provided
(3) No resistance to inhalation
(4) Surplus air provides cooling and refreshing effect

b. Disadvantages:
(1) Failure of mechanical air supply could jeopardize safety of wearer
(2) Trailing of the hose connected to face piece from air source

c. Methods of supplying air are by:
(1) Constant flow
(2) Demand flow

d. Constant flow type
(1) Continuously fed to facepiece
(2) Positive pressure in facepiece assures against inward leakage
(3) Pressure maintained by compressor
(4) Mostly of low pressure centrifugal design
(5) Size of blower depends upon number of masks to be serviced
(6) Pressure on line must be maintained in accordance with proper respiratory levels
(7) U.S. Bureau of Mines specifies maximum pressure of twenty-five pounds p.s.i.
(8) Reducing relief or blow-off valves used control pressure
(9) Precautions must be taken to assure clean air source at blower

REFER learners to Figs. 5, 6 & 7, pp. 206-207 Fire Service Training (text), and DISCUSS following:

Instructor's Notes

- (10) Assembly and carrying equipment
- (11) Air hose construction
  - (a) Highly resistant to petroleum liquids, vapors, and chemicals
  - (b) Wire reinforcement against crushing
  - (c) Up to 150 feet of hose can be used
  - (d) Air hose connection and support to body
  - (e) Facepiece and flexible connection

e. Demand flow type

- (1) Cylinder of compressed air or oxygen used in place of blower
- (2) Demand regulator supplies air only on inhalation
- (3) Conserves air supply
- (4) Permits one man several hours of service from 220 cubic foot cylinder

6. Self-contained Breathing Apparatus

a. Provides protection in any concentration of gases, or oxygen deficiency

b. Breathing is independent of surrounding atmosphere

c. No outside air is admitted to system

d. Three basic types are -

- (1) Oxygen or air cylinder apparatus
- (2) Demand apparatus
- (3) Self-generating apparatus

e. Demand Type Apparatus

RELATE general information as to -

- (1) Compressed air or oxygen
- (2) Flow regulated by breathing
- (3) Pressure gauge
- (4) One-quarter and one-half hour supply
- (5) EMPHASIZE adherence to instructions and information by manufacturer

f. Putting on Demand Type Apparatus

***DEMONSTRATE** putting on mask in accordance with instructions on pp. 207-209, Fire Service Training (text). Have learners **PRACTICE** same procedure, making corrections as needed.*

g. Precautions and Practices

- (1) Amount of exertion by wearer is related to the period of time used
  - (a) 15 minutes for small units (approximate)
  - (b) 30 minutes for large units (approximate)
- (2) Check pressure gauge periodically for time limitation
- (3) Return to fresh air when needle on gauge approaches solid color section

Instructor's Notes

(4) Remaining air (300 p.s.i.) will only last -
  (a) Two or three minutes on small units
  (b) Four minutes on large units
(5) By-pass (red) valve is normally kept closed
(6) By-pass (red) valve is opened when automatic demand regulator becomes inoperative
(7) When the by-pass (red) valve is opened, the main line (yellow) handwheel should be closed, and then the by-pass valve adjusted for proper air flow

h. Removing the mask

***DEMONSTRATE** removal of mask in accordance with instructions on p. 209, Fire Service Training (text). Have learners **PRACTICE** same procedure, making corrections as needed.*

i. Care of breathing apparatus at station
(1) Sterilization of facepiece
(2) Replacement of cylinder
  (a) Disconnecting
  (b) Releasing cylinder
  (c) Replacing cylinder
  (d) Check pressure release
(3) Placing apparatus in case for storage
(4) Emphasize warning about oils and greases

7. Self-generating Oxygen Mask (Chemox)
a. Generates own oxygen supply
b. Supply independent of outside atmosphere
c. Exhaled breath passes into cannister
d. As it passes through cannister, exhaled breath is purified of carbon dioxide and replenished with oxygen
e. It is then rebreathed
f. This cycle continued during use
g. Provides protection for approximately forty-five minutes

***REFER** learners to Fig. 10, p. 210, Fire Service Training (text). **DISCUSS** method of operation.*

h. Apparatus consists of:
(1) Facepiece
(2) Breathing tubes
(3) Breathing bag
(4) Breastplate
(5) Cannister holder
(6) Harness straps
(7) Manual timer
(8) Facepiece assembly is equipped with pressure relief valve

Instructor's Notes

(9) Breathing bag serves as:
  (a) Reservoir for manufactured oxygen
  (b) Acts as cooler for air from cannister, as the chemical action taking place in the cannister generates heat

(10) Wearer is protected from heat by insulation on breast plate

(11) Normal breathing releases enough moisture to create oxygen. However, excessive moisture results in a sudden reaction resulting in an increased supply of oxygen
  (a) Therefore, water should not be introduced into a used or unused cannister

i . Putting on self-generating oxygen mask

***DEMONSTRATE** putting on mask in accordance with instructions on pp. 210-213, items 1 through 11, Fire Service Training (text). Have learners **PRACTICE** this procedure making corrections as needed.*

j . Precautions and practices

***DISCUSS** the following information:*

(1) No need to purge nitrogen manually, as sufficient oxygen is produced

(2) How to relieve excess pressure

(3) Two indications that will indicate an expended cannister--
  (a) Fogging of lenses on exhalation
  (b) Increased resistance to exhalation
  (c) These will not normally appear until after forty-five minutes of use
  (d) May appear under extreme use condition

(4) Do not confuse excess breathing bag pressure with cannister resistance

(5) If exhalation resistance is still present after relieving pressure, it indicates the cannister is about expended, and wearer must return to fresh air

k. After use

***DEMONSTRATE** removal of mask in accordance with instructions on p. 214, Fire Service Training (text). Have learners **PRACTICE** this procedure, making corrections as needed.*

***DEMONSTRATE** and **DISCUSS** removal and disposal of cannister in accordance with instructions on p. 214, Fire Service Training (text).*

(1) Care of mask at station
  (a) Sterilization of facepiece, hang down while cleaning
  (b) Do not keep cannister in holder while in carrying case

Instructor's Notes

(c) Keep the cannisters in carrying case
(d) When cannister has once been used, never use again
(e) Emphasize precautions against oils and greases
(f) Keep face away from opened cannister
(g) Check inhalation and exhalation valves for corrosion periodically. Replace when not operating properly
(h) Check plunger and plunger casting periodically for cleanliness and proper operation
(i) Check tightness of valves and fittings periodically
(j) When any part shows evidence of failure, replace immediately
(k) Damaged apparatus should be returned to factory for repair

(2) Do not use apparatus for under water rescue
(3) Do not tie guide line or rope to D-ring on harness strap
(4) EMPHASIZE adherence to instructions and information provided by manufacturer

8. One-half Hour Self-generating Oxygen Mask

REFER learners to Figs. 18, 19 & 20, pp. 215-217, Fire Service Training (text). INFORM class, that in principle , it has the same general functions as the regular Chemox Mask. However, there are some differences, namely:

a. Thirty minute protection
b. Inhaled and exhaled air pass through one tube
c. Automatic pressure relief valve
d. Quick starting feature for low temperature
e. Cannister is cylindrical in shape and has opening in each end
f. Putting on One-half Hour Self-generating Oxygen Mask

DEMONSTRATE putting on mask in accordance with instructions on pp. 216-217, items 1 through 13, Fire Service Training (text). Have learners PRACTICE this procedure, making corrections as needed.

g. When using mask:
(1) Breathe normally
(2) Set timer at 30. Bell will ring for 12 seconds when pointer returns to 0
(3) Return to fresh air when alarm rings

h. Proper care and maintenance of apparatus, and safe disposal of cannister is the same as to be followed with regular Chemox mask

Instructor's Notes

i. **EMPHASIZE adherence to instructions and information provided by manufacturer**

C. AUDIBLE COMMUNICATIONS WITH RESPIRATORY PROTECTIVE EQUIPMENT

1. Importance of speaking diaphragm

D. TRAINING SUGGESTIONS

Have learners PRACTICE the following:

1. Wear mask for short period in fresh air and work or exercise
2. Wear mask in gas or smoke atmosphere
3. Wear mask in gas or smoke atmosphere while working
4. Practice donning mask with and without helper

E. SUMMARY

1. Work in pairs
2. Do not don mask when short of breath
3. All harness straps should be fully extended to fit largest man
4. Learn twisting technique of harness straps for quick adjustment
5. When working in highly contaminated areas, do not remove mask until contaminant has been removed
6. Always adjust headbands as shown in Figs. 21 & 22, p. 218, Fire Service Training (text)
7. Always carry extra tanks or cannisters on fire apparatus
8. Do not fasten guide line or rope to D-ring
9. When using guide line or rope, fasten around body before donning mask
10. In cases of infrequent use, masks should be removed periodically from case, and donned by personnel. This will insure pliability of materials

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 12 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

***REVIEW** Assignment Sheet No. 12, re-teach any portion of lesson not thoroughly understood.*

TEACHING GUIDE #13

ADVANCE INFORMATION - THE ALARM

OBJECTIVES:

1. To convey to the learner the importance of advance information in efficient and effective fire fighting.
2. To acquaint the learner with the information he should know before the fire occurs.
3. To have the learner understand how alarms are transmitted and received.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Charts, slides and inspection film if available

REFERENCE:

Fire Service Training (text), Chapter 13, pp. 219-220.

Instructor's Notes STEP I - INTRODUCING THE LESSON:

Proper procedure and pre-planning are essential to success in any undertaking and fire fighting is no exception. If fire departments are to make effective use of their manpower, apparatus and equipment in combating fires and other emergencies, they must have advance information relative to the area we protect. This information includes street or road locations, building locations, types of occupancies, type of structure, physical layout and built in fire protection facilities. Knowledge of the available water supply in the community and a complete understanding of how alarms are transmitted and received are of utmost importance. The purpose of this chapter is to provide an outline to serve as a guide in obtaining and learning this information.

STEP II - PRESENTING THE LESSON:

A. ADVANCE INFORMATION
   1. Information Necessary Before a Fire Occurs
      a. Location
         (1) Knowledge and location of all property protected is essential to meet fire fighting problems

Instructor's Notes

- (a) Enables determining the best possible route to the scene of the emergency
- (b) Enables determination of the best possible action to take with the facilities available
- (c) Accomplished through inspection systems
- (d) Making a study of the geographical layout of the area protected by:
  - (d-1) Use of city, township, and county maps
  - (d-2) Each department preparing a map of their district, showing streets, roads, available water supply, and hazardous building locations

b. Building construction
- (1) Brick with steel supporting beams
- (2) Brick with wood supporting beams
- (3) All frame construction
- (4) Number of stories
- (5) Type of roof - flat, pitched, wood or concrete
- (6) Type of roof covering - asbestos, asphalt, metal, slate or wood shingle
- (7) Type of windows or if building is windowless in certain areas
- (8) If building is air conditioned, location of ducts and master shut-off switch
- (9) Location of exits, stairways, elevator shafts, utility ducts, gas, electric, water shut-off, cellar drains, etc.
- (10) Does building have fire walls

c. Type of occupancy
- (1) Industrial, mercantile, commercial, residential or public
- (2) Institutional - hospital, rest home, jail, children's home, etc.
- (3) When occupied - day, night, 24 hours or seasonal

d. Contents of building
- (1) Whether slow or fast burning or both
- (2) Whether explosive material might be present
- (3) Characteristics of extremely hazardous chemical and other flammable materials. Will they react with water, etc.

e. Built-in fire protection facilities
- (1) Sprinkler systems, standpipe, fire doors or other private protection
- (2) Location of sprinkler shut-off valves, siamese connections

Instructor's Notes

(3) Type of sprinkler system - wet, dry or manually operated
(4) Water supply for sprinkler system - gravity tank, mains, cistern, etc.

f. Water supply
  (1) Size of mains and water pressure in various areas
  (2) Location of hydrants
  (3) Volume of water that might be obtained from hydrants
  (4) Are hydrants located on dead end mains
  (5) Secondary choice of hydrants if unable to use those close to the building involved
    (a) Volume of water that might be expected from these hydrants
  (6) Other water supply that might be utilized:
    (a) Cisterns, ponds, lakes, streams, etc.
    (b) Tankers of own department or mutual aid companies

2. Fire Apparatus and Equipment Available
  a. Pumpers, ladder trucks, tankers, emergency and rescue squads
  b. Check apparatus you are assigned to at regular intervals
  c. Know location and use of all equipment

B. THE ALARM

1. EXPLAIN that an efficient alarm system must provide two essentials
  a. Some ready means of summoning apparatus and men to the scene of the fire
  b. In communities where combined paid and volunteer or volunteer organization are used, an adequate means of notifying firemen of the existance of a fire must be provided

2. Types of Alarms
  a. Street box located on pole, pedestal or on a building
  b. Similar alarm boxes, located in industrial and institutional buildings, etc.
    (1) Operated by pulling a lever on or in the box
    (2) Sending an alarm into fire headquarters and/or all outlying stations
  c. Telephone alarm boxes
    (1) Telephone in a box similar to a convential fire alarm box

Instructor's Notes

- (2) Allowing informant to pick up phone in the box and call directly into fire headquarters
- d. Automatic alarm systems
  - (1) Sprinkler alarm systems
    - (a) When sprinkler head releases, alarm is sent into a central headquarters of a servicing agency (ADT)
    - (b) The alarm is retransmitted to fire headquarters
  - (2) Heat detecting devices and rate of rise systems
    - (a) Heat detecting devices operate when certain temperatures are reached in an area. EXAMPLE - 140° upward
    - (b) Rate of rise operates when there is a rapid rise of temperature in the area. EXAMPLE - almost instant rise of temperature from 80° to 110°
- e. Telephone
  - (1) Convential type of phone located in the home or other type of occupancies
    - (a) Allowing informant to contact the fire department through the telephone operator
    - (b) By calling a given number for fire calls only
- f. Verbal
  - (1) By a person going directly to a fire station or alarm headquarters
  - (2) By a person going to a fireman's home where in certain localities, the alarm may be sounded from his home

3. Notifying Responding Fire Personnel
- a. Bell or gong system and public address system
  - (1) After the alarm is received in communication headquarters
    - (a) It is transmitted to either the responding companies or all companies which sound the alarm in their fire stations
    - (b) A certain number of licks on the gong designating the location by a prearranged running code
  - (2) By verbally informing the companies over a public address system as to:
    - (a) The nature and location of the emergency
- b. Siren, bell or a whistle system
  - (1) Activated from point of alarm reception
  - (2) Activated manually

ADVANCE INFORMATION - THE ALARM

Instructor's Notes

c. Telephone system

(1) Firemen may be called at their home by person who receives the alarm

(2) Call system - where each fireman after receiving the original call may have someone in his family call several other firemen

(3) Other special systems

d. Radio

(1) Transmitted from a base station located in alarm headquarters to all motorized equipment (Chief's car, apparatus, etc.)

(2) Transmitted from a base station at alarm headquarters to monitoring units located in fire stations and firemen's homes

(3) Regular alarm system (siren, gong, or whistle) is still sounded even though radio transmission is used

e. Delayed alarms

(1) Delayed alarms are very high on the list of factors responsible for large loss fires

(2) Causes of delayed alarms

(a) People not being familiar with the telephone number and other procedures of notifying the fire department

(b) Individuals attempting to extinguish the fire themselves and not attempting to have anyone notify the fire department, thereby delaying the alarm

(c) The first five minutes is the most important time for any fire department to reach the scene of a fire, statistics show that some fires have reached conflagration proportions shortly after nine minutes

4. Public Educational Program

a. Local newspapers, radio stations, television stations and other media can be used to advise the public how to turn in an alarm to the local fire department in case of fire

b. Printed cards, having the fire department telephone number, to be attached to or placed near the telephone can be distributed to the public

5. Alarm System Maintenance

a. The alarm system is the primary method of receiving alarms by a fire department

b. Regardless of the type of system used, it must be properly designed and maintained

Instructor's Notes

C. ***Have Local Fire Alarm System explained to class.***

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 13 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 13, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #14

SIZE-UP

OBJECTIVES:

1. To learn the importance of size-up.
2. To acquaint firemen with a step-by-step method to follow in making the size-up.
3. To study a plan of procedure to follow and conditions that may be encountered in using the step-by-step method.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad

REFERENCE:

Fire Service Training (text), Chapter 14, pp. 221-223.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

The initial action of a fire department at a fire is very important. Proper systematic procedure in making the size-up can mean the difference between success and failure. Clear thinking and quick action under an adopted system will result in a good size-up. All officers and firemen that have the responsibility for the action of the department at a fire, should know how to make a proper size-up intelligently.

STEP II - PRESENTING THE LESSON:

Definition of size-up - size-up, as it relates to the fire service, is the process of making a quick analysis of the situation at hand by the person in charge.

A. ESSENTIAL FACTS
  1. Life Hazards
    a. The occupants of the involved and adjacent buildings
    b. Bystanders
    c. Own personnel
  2. Time of Emergency
    a. Month
    b. Day.
    c. Hour

Instructor's Notes

3. Location of Emergency
    - a. Location of building or buildings involved
    - b. Position of building in relation to streets, alleys, open spaces and other buildings
    - c. General physical surroundings
    - d. Overhead obstructions
    - e. Parked cars
    - f. High voltage lines
    - g. Blocked streets and alleys
4. Nature of Emergency
    - a. Fire
    - b. Explosion
    - c. Smoke or chemicals
    - d. Accident of other nature
5. Exposures
    - a. Life (occupants in exposed buildings)
    - b. Property (buildings, cars, etc.)
6. Buildings (involved)
    - a. Due to the fact that there is limited time and opportunity for an officer to recognize essential facts at a fire, knowledge must be gained on buildings
    - b. The following information must be obtained prior to the emergency through a systematic survey and inspections:
        - (1) Height
        - (2) Size
        - (3) Construction
        - (4) Occupancy
        - (5) Contents
        - (6) Age
        - (7) State of repair
        - (8) Interior layout
        - (9) Air conditioning system
        - (10) Sprinkler system
        - (11) Standpipe system
        - (12) Hydrants, service available
7. Fire
    - a. The officers estimate will depend upon his advanced knowledge of fire fighting fundamentals and experience obtained through extensive study and practice in relation to:
        - (1) Smoke (color, odor, and density)
        - (2) Nature of burning material
        - (3) Location of fire (in building)
        - (4) Stage of development
        - (5) Potential of area that may become involved

Instructor's Notes

- (6) Location of base of fire
8. Weather
   - a. Weather conditions at the time of the fire are very important considerations
     - (1) Wind - (direction and velocity)
     - (2) Temperature
     - (3) Rain
     - (4) Snow
     - (5) Ice
9. Apparatus, Equipment and Manpower
   - a. Those responding to the alarm
     - (1) Number of men
     - (2) Pumping capacity
     - (3) Hose
     - (4) Ladders
     - (5) Special equipment (light plants, smoke ejectors, etc.)
   - b. Those on standby status
     - (1) What will answer the multipal alarm
     - (2) Mutual aid available
10. Built-in Fire Protection Equipment
    - a. Sprinklers and standpipes
    - b. How supplied
    - c. Location of fire department connections
11. Water Supply
    - a. Officer should have the following information before the emergency, not after one develops
      - (1) Source of supply
        - (a) Street mains
        - (b) Hydrants
        - (c) Rivers - ponds - lakes
        - (d) Tank wagons
    - b. Amount of water available
      - (1) Hydrants
        - (a) Volume
        - (b) Pressure
    - c. Tank wagons
      - (1) Number available
      - (2) Capacity
    - d. Portable pumps
      - (1) Number
      - (2) Capacity

B. DECISION

1. Accumulate all essential facts
2. Keep in mind principles of fire fighting tactics

Instructor's Notes

3. Sometimes a prompt decision must be made based on a minimum amount of available facts to meet the immediate situation
4. Do not hesitate to change decision when additional information becomes available
5. Decision should represent a clear and precise picture of the action the officer intends to take
6. Orders and instructions to officers and men:
   a. Should be clear and concise
   b. Action may be required to effect rescue, lay hose lines, etc., before completion of final decision of initial size-up
   c. Junior officers should be advised of existing situations, decision, and plan of operation
      (1) Good communications are necessary
7. Supervision
   a. Keep fully informed as to the progress of operation and any new develompents
   b. Large fires require assistance of junior officers to assist in supervision
   c. Situations may change whereby secondary or supplemental decisions require immediate changes in supervision plans
   d. Officer should devote his entire time at fire in the supervision of personnel in order to effect the plan of operation
8. The officer should not under estimate the importance and effectiveness of primary fire protection equipment

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 14 in Learners Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 14, re-teach any portion of lesson not thoroughly understood.

FORCIBLE ENTRY

OBJECTIVES:

1. To acquaint the learner with the different methods of forcefully making entry into a building when all accessible doors and windows are locked.
2. To acquaint the learner with the ways of using fire department tools efficiently when making forcible entry into a building
3. To have the learner become an efficient forcible entry craftsman, so that he may enter a building causing the least amount of property damage. At the same time, protecting himself and others around him, thereby, creating better public relations.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Forcible entry tools - axe, crowbar, pike pole, etc.
3. Use doors and windows in class room to illustrate how they open and close (in or out, how they are hinged and locked, etc.)
4. Power tools if available - air hammer, sawsall, etc.
5. Charts, movie film and slides if available

REFERENCE:

Fire Service Training (text), Chapter 15, pp. 224-230.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

The definition of forcible entry in fire department terminology is, "gaining entrance into a burning building or other buildings where an emergency exists, using a forceful means when all avenues of entrance are locked or inaccessible, resulting with a minimum amount of delay and damage."

To perform efficiently when making forcible entry requires complete knowledge of the tools that can be used, and skill in the use of the tools. Knowledge of building construction is important, such as: the different types of windows, how they open and how they are locked; the various types of doors, how they are set in their frames, how they open (in or out); the various types of locks on doors and windows (panic hardware, etc.); the various types of roofs, wood, concrete, concrete slab, and etc.

Instructor's Notes

Coordination and application of the knowledge of building construction and use of forcible entry tools will enable firemen to rapidly gain entrance into a locked building with a minimum of property damage.

STEP II - PRESENTING THE LESSON:

As stated before, when making a forcible entry, firemen must be thoroughly familiar with the methods and tools used in order to do an efficient job.

REVIEW some of the commonly used forcible entry tools described in Chapter 9.

A. SHOW AND DESCRIBE TOOLS (if available)

1. **Various types of axes**
2. **Claw and Kelly tools**
3. **Roof cutter**
4. **Wrecking bar - crow bar**
5. **Door openers**
6. **Battering ram**
7. **Power tools**

B. WHERE ENTRY MAY BE MADE

1. **Breaking glass, including tempered glass**
2. **Various types of doors**
3. **Various types of windows including storm windows**
4. **Roof - skylight, cock loft or scuttle hole cover**
5. **Gratings - dead lights, barred windows**
6. **Breaching walls**
7. **Partitions and ceilings**

C. HOW ENTRY CAN BE MADE

1. **Breaking Glass**

   REFER learners to Fig. 1, p. 224, Fire Service Training (text).

   a. **May be accomplished by using the flat side of a fire axe**
   b. **Stand to one side and strike the upper part of glass first**
   c. **Prevents glass from sliding down axe handle and cutting hands**
   d. **Remove all jagged pieces from sash**
   e. **Wire glass - cut at edge of sash with blade of the axe**

Very little information relative to tempered glass, full-vision doors is included in the training manual. Following is a brief explanation of the characteristics of tempered glass and also a method for breaking it.

The use of tempered glass or full vision doors in modern buildings is increasing rapidly. Usually, there is no frame around glass and the locking hardware is at the top or bottom. The glass is much thicker than ordinary plate glass and is heat tempered. The tempering

Instructor's Notes

produces high tension stresses in the center of the glass and compression stresses at the exterior surface. Tempering increases the flexibility and the strength approximately four times. It is several times more resistant to shock, pressure and impact and will withstand without breaking, temperatures of 650^{o} on one side, while the other side is exposed to atmospheric temperatures.

The doors are custom built and are very costly (several hundred dollars) and six to eight weeks time is required to produce a replacement. A tempered glass door should never be broken if any other means of entry is available.

The glass cannot be broken by blunt instruments. Tests have shown that a sledge hammer and the heel end of a ladder used as a battering ram by firemen, failed to break the glass.

To break the glass, a sharp pointed instrument must be used to penetrate the hard exterior surface of the glass. If it is absolutely necessary to break the glass, use the pick end of a fire axe. The following procedure is recommended: If a CO^2 extinguisher is available, apply the gas to the door (sudden cooling will cause contraction) then stand to one side, face away from the door and strike the door a sharp blow with the pointed end of the axe. As the hard surface is penetrated, the glass will disintegrate into small pieces. Remember, as the glass is being broken, turn face away from the door. This serves as a protective action against eye injury.

2. Entry Through Doors

REFER learners to appropriate figures when discussing, Figs. 2 through 8, pp. 225 & 226, Fire Service Training (text).

a. Before forcing a door, make sure it is locked. Try opening it by hand
b. Residential doors open inwardly, public building doors should swing out
c. Select tools best adapted
d. At times, it is advisable to break glass to force entrance, because it is easy to break and most easily replaced
e. If hinged side is exposed, remove hinges
f. If the door has glass, break glass and then manipulate lock from the inside
g. Revolving and steel doors offer great resistance
h. Method of collapsing revolving doors should be learned during inspection tours
i. Method of opening steel doors should be studied before fire occurs

DEMONSTRATE, from illustrations on pp. 225-226, the various types of doors, the most efficient manner used to gain entrance and proper tools to use.

3. Entry Through Windows

REFER learners to appropriate figures when discussing, Figs. 9, 10 & 11, pp. 226-227, Fire Service Training (text).

Instructor's Notes

a. General types - factory, casement, basement and check-rail
b. Determine whether the window can be opened before forcing entrance
c. Select proper tools
d. Avoid unnecessary damage

***DEMONSTRATE** or draw on blackboard and **EXPLAIN** the various types of windows, most effective manner used to gain entrance, and the proper tools to use.*

e. Recommended procedure of making entry through storm doors and storm windows
   (1) To break glass and unlock from the inside
   (2) Rather than causing damage to the metal frame
   (3) Wood doors and windows may be forced

4. Making Entry From Roof

***REFER** learners to appropriate figures when discussing, Figs. 12, 13 & 14, pp. 227-228, Fire Service Training (text).*

a. Types of roofs - wood, concrete slab, etc.
b. Types of roof covering - metal, slate, asphalt, tar and gravel, etc.
c. Remove roof covering exposing sheathing
   (1) Sheathing - usually 3/4" thick and may be tongue and grooved
   (2) Plywood - 1/2" thick and 4' x 8' size is used extensively
d. When cutting holes with a fire axe, use short quick strokes
e. Cut at a 45° angle to the grain of wood rather than straight across
f. When cutting holes through roofs, floors and walls, always cut as close to the rafters, joists and studs as possible
g. When cutting roof boards, always stand on the windward side
   (1) Complete cut before removing any boards
   (2) Stand on the windward side and remove the boards with the pick end of an axe
      (a) Starting with the board farthest from you
h. If plywood is used instead of sheathing, remove an entire section
i. Pike pole may be needed to pierce ceiling below

5. Entry Through Sky Light, Cock Loft, or Scuttle Hole Cover

a. Sky light - use the pick point of an axe to pry up on the frame

***REFER** learners to Fig. 15, p. 228, Fire Service Training (text).*

Instructor's Notes

(1) On some skylights, the bottom section of the frame around the glass can be removed
  (a) If so, slide the glass out of the frame
(2) If the sky light cannot be pried up or the glass removed:
  (a) Break the glass and remove the jagged pieces
  (b) Reach inside and release hooks or bolts

b. Cock loft and scuttle hole cover - use the same prying procedure
  (1) If this method is not successful, it must then be cut open with an axe

6. Entry Through Gratings, Dead Lights and Barred Windows
  a. Gratings may be lifted off their sill by prying upward with an axe or crow bar
    (1) If locked and hinged, break the lock and follow the same prying procedure
  b. Dead lights - break the seal around the steel frame work that holds the glass dead light discs
    (1) After seal is broken, remove the steel frame work
  c. Barred windows normally set in masonry can be removed by:
    (1) Strike the bar with a sledge hammer, ten inches above the sill
      (a) Causing it to bend and break loose from the masonry
    (2) Strike the masonry sill with a sledge hammer directly in front of the bar, breaking away the masonry
    (3) Use an acetylene cutting torch to cut the bars
    (4) Large size bolt cutters may also be used

7. Entry By Breaching Walls
  a. Brick walls - remove one brick with a pick-headed axe or other suitable tool
  b. After removal of a brick, two men should grasp the battering ram and swing the ram back an arms length

  REFER learners to Fig. 16, p. 229, Fire Service Training (text).

    (1) Quickly thrust the ram against the wall with a slight lifting motion as it strikes the brick
  c. Brick should be removed one at a time and the hole cut in a diamond shape to keep from weakening the wall

Instructor's Notes

8. Entry Through Partitions and Ceilings
   - a. Partitions
     - (1) Spread a tarpaulin on the floor beneath the spot the hole is to be made
     - (2) With the blade of an axe, cut down along the stud
     - (3) Cut the hole between studs. Be as neat as possible

       REFER learners to Fig. 17, p. 229, Fire Service Training (text).
     - (4) Do not tear off the lath
     - (5) Studs are usually set 16" on center and can be located by gently sounding the wall
   - b. Ceilings
     - (1) When opening ceilings from below, the pike pole or plaster hook is used

       REFER learners to Fig. 18, p. 229, Fire Service Training (text).
     - (2) DEMONSTRATE the proper method of removing plaster, lath, metal lath and metal ceilings

       REFER learners to Figs. 19 & 20, p. 230, Fire Service Training (text).

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 15 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 15, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #16

RESCUE

OBJECTIVES:

1. To acquaint the firemen with the principles governing rescue practices.
2. To learn the proper use of tools and equipment, and the various carries and drags necessary to effect rescue.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Blankets
3. Ladders

REFERENCE:

Fire Service Training (text), Chapter 16, pp. 231-254.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

No greater service can be given by any fire department than that of saving a human life. When a fire or other emergency occurs, it is the duty of the fire department to be equipped and thoroughly trained to render quick and efficient service, with equipment which must be maintained in first-class condition.

STEP II - PRESENTING THE LESSON:

A. RESCUE PRINCIPLES AND PRACTICES

1. EXPLAIN that rescue is the removal of human beings from places involved in fire, or other emergencies. Questions to be considered regarding rescue are:
   a. Are there any people in the building?
   b. If so, are they in danger?
   c. Has there been a cry for help?
   d. Can they be rescued?
   e. How can they be rescued?
   f. Has any information been given by the people who have escaped from the building?
   g. Has any information been given by the neighbors or bystanders regarding people in the involved building?

Instructor's Notes

2. With the previous questions answered, the officer in charge should determine if anyone is trapped in the building
    a. A careful search should be made when there is a chance of anyone having failed to escape from the involved building
        (1) Children may hide in closets, under beds and furniture
        (2) Adults may be found by windows or doors they have tried to open
        (3) REMEMBER - it takes only a small amount of heated air, gas, or smoke to render a person unconscious
3. Essential information necessary to meet rescue problems intelligently are:
    a. Construction and interior layout of building involved
    b. Number of people likely to be in building
    c. Location of interior and exterior stairways
    d. Location of exits
    e. Openings to roofs of adjoining buildings which could be used for rescue
4. Time and nature of occupancy have direct relation in rescue problems
    a. Hotel fires more serious in early morning hours
    b. School fires more serious when school is in session
    c. Age, sex, and physical conditions may make rescue more difficult
        (1) Firemen should make a community survey for aged people and invalids
        (2) Complete record on file of locations of homes for children and aged, jails, hospitals, and other institutions
5. Weather conditions have an important bearing on rescue problems
    a. In winter storm windows create problems
    b. Snow will slow operations
    c. May endager health of victims after rescue
6. Rescue procedures will differ from case to case
    a. No set rule to follow
    b. Time is always pressing and people must be rescued quickly
    c. Sometimes ladders will do the job
    d. Sometimes ladders, streams, and ventilation are required
    e. Rescue is a teamwork operation for all men at the scene of the emergency

Instructor's Notes

B. TYPES OF RESCUE EQUIPMENT

Some of this equipment was covered in previous chapters.

1. Axe
2. Rope
3. Ladders
4. Gas Masks
5. Fire Streams
6. Stretcher
7. First-Aid Kit
8. First-Aid Training
9. Cutting Torch
10. Heavy Equipment for Use at Railroad Wrecks, etc.
    - a. Consists of tow trucks, heavy jacks, cables, block and tackle, steam shovels, bulldozers, etc.
    - b. Have listing of places where to obtain this heavy equipment in department files
    - c. Permission to use this equipment should be obtained before it is needed
11. Life Nets

C. OPERATING AT SCENE OF DROWNING

1. Only Trained and Qualified Men Should Receive This Assignment
2. Wear Life Jackets While in Boat
3. Keep One Man on Shore
    - a. To gather information
    - b. To get help for men in boat if they should get into trouble
4. General Information on Drowned Bodies
    - a. A body will remain near the spot of drowning
        - (1) 1-1/2 x the depth of water = the distance the body may travel from spot
            - (a) EXAMPLE: water is 20 ft. deep. 1-1/2 x 20 = 30 ft. the body may travel
    - b. Very fat bodies may not sink, but remain floating on top of the water
    - c. Body may remain under water from 18 to 24 hours
        - (1) Depends on water temperature
        - (2) Contents of stomach
        - (3) Body will rise slowly as gas is formed
        - (4) Victims drowned in rapid waters will probably be found in the first deep hole, down stream
5. Dragging
    - a. Is a blind operation
    - b. EXPLAIN grappling hooks

      ***REFER** learners to Fig. 4, p. 236, Fire Service Training (text).*

Instructor's Notes

        (1) Made of wire
    c. EXPLAIN pike pole iron

6. Size-up before and during the operation will help make a rapid and successful recovery
    a. Size-up should include:
        (1) How long has the victim been under the water?
        (2) Where was he last seen?
        (3) How was the victim dressed (swimsuit or clothes)?
        (4) Survey of body of water
            (a) Type of bottom
            (b) Currents
            (c) Snags and obstructions
            (d) Depth and width of water
            (e) Bank conditions
            (f) Direction of wind
7. How to Locate Body for Grappling

    DRAW Fig. 6, p. 237, Fire Service Training (text), on chalkboard and EXPLAIN.
8. Methods of Grappling
    a. EXPLAIN shore-to-shore grappling
    b. EXPLAIN boat-to-shore grappling

        DRAW Fig. 7, p. 237, Fire Service Training (text), on chalkboard and EXPLAIN.
    c. EXPLAIN boat-to-boat grappling

        DRAW Fig. 8, p. 238, Fire Service Training (text), on chalkboard and EXPLAIN.
    d. EXPLAIN grappling from moving boat
    e. EXPLAIN grappling with pike pole iron

        REFER learners to Figs. 9-10, pp. 238-239, Fire Service Training (text).

D. CUTTING TORCHES
1. Used to Cut Steel, Wrought Iron and Other Ferrous Metals
2. EXPLAIN and SHOW how to Assemble Cutting Torch and Hose
3. EXPLAIN Operation of Pressure Regulators
4. EXPLAIN Safe Handling of Cylinders
    a. Oxygen
    b. Acetylene
5. EXPLAIN Attaching Regulators to Cylinder
    a. Turning on
    b. Turning off
6. EXPLAIN Putting Torch in Operation
    a. Select tip
    b. Check for leaks
    c. Adjust for proper pressures

        REFER learners to Fig. 12, p. 241, Fire Service Training (text).

Instructor's Notes

d. EXPLAIN cutting procedure and DEMONSTRATE if possible
  (1) Preheat metal
  (2) Keep tip at constant distance
  (3) Move at uniform speed
  (4) Turn acetylene off first

7. Precautions When Using Cutting Torch
   a. Operator should wear gloves and goggles
   b. Protect victim
   c. When using, have man standby with extinguisher
   d. Overhaul after cutting
8. Cutting Torch Care
   a. Always use good wrench
   b. Never use oil or grease on parts
   c. Always check for leaks before lighting
   d. Have regulators in off position before turning on tanks
   e. Protect hose from cuts, etc.
   f. Keep torch in box for storage
   g. Check hose for deterioration
   h. Check goggles for breaks or dirt
   i. Inspect tanks for leaks and see that pressure is maintained

E. LIFE NET PROCEDURES
1. Removing Net from Apparatus
2. Running With Net
3. Spotting Net
4. Holding Net
5. Making Adjustment to Catch Person
6. Removing Person from Net

F. CARRIES AND DRAGS
1. EXPLAIN - that in fire situations, injured and unconscious victims must be rescued quickly and safely
2. Carries and drags may be the only way to accomplish this operation
3. Drags must be used when victim is too heavy to carry

DEMONSTRATE and PRACTICE all of the following carries and drags. Screen men for recent operations, ruptures, etc., excuse men who are not physically fit. All others must practice all carries and drags until they become efficient in the performance.
REFER to the appropriate figures as illustrated in the Fire Service Training (text).

Instructor's Notes

1. Chair Carry - Fig. 13, p. 243
2. Fireman's Carry - Fig. 14, p. 243
3. Carrying in Arms - Fig. 15, p. 243
4. Carrying Astride Back - Fig. 16, p. 243
5. Front Piggy Back - Fig. 17, p. 244
6. Pack Strap Carry - Fig. 18, p. 244
7. Two-man Seat Carry - Fig. 19, p. 244
8. Carrying by the Extremities - Fig. 20, p. 245
9. Three-man Carry - Fig. 21, p. 245
10. Clothes Drag - Fig. 22, p. 246
11. Fireman's Drag - Fig. 23, p. 246
12. Blanket Drag - Fig. 24, p. 246

G. LADDER RESCUE

***DEMONSTRATE** and **PRACTICE** the following, **REFER** learners to appropriate figures as illustrated in the Fire Service Training (text).*

1. Sliding an Unconscious Person Down a Ladder - Fig. 25, p. 247
2. Walking a Victim Down a Ladder - Fig. 26, p. 246
3. Walking a Woman or Child Down a Ladder
4. Sliding a Victim Down a Ladder Across Arms - Fig. 27, p. 247

H. CARE OF VICTIMS AFTER RESCUE

1. EXPLAIN that care must be taken to prevent victims, that have been rescued, from returning into building
    - a. The duty of the fire department does not end after the rescue
    - b. The victims should be supervised and properly cared for after being brought to safety
2. Care of Infants:
    - a. Sudden drop in temperature may cause pneumonia or other illness
    - b. Make sure they are properly covered
    - c. Protect face
    - d. Deliver to a competent person
3. Care of Children:
    - a. If left on their own, they may wander around and be injured
    - b. They may return into building to get a toy or pet
    - c. Deliver to a competent person
4. Care of the Sick
    - a. Contagious disease
    - b. Non-contagious
5. Care of the Aged:
    - a. Place in custody of a competent person

Instructor's Notes

b. Firemen should bring out cherished objects
c. Remove from the fire grounds as seeing their possessions burn may cause a heart attack, etc.

I. ADMINISTRATION OF OXYGEN

1. Methods Should be Known by all Firemen
2. May Mean Life or Death
   a. To the victim
   b. To their fellow firemen
3. Knowledge of Artificial Respiration is a Must

J. ELECTRICAL RESCUE

1. Firemen Must be Able to Recognize Electrical Hazards
2. Saving of Property Alone should not Justify the Risk of a Man's Life
3. Fireman not Qualified and Equipped to Properly Handle the Hazard Should Wait for the Power Company
4. All Fallen Wires are Dangerous
5. Wires Down
   a. Notify power company and move crowd away
   b. The spans of wire adjacent to the trouble may be weakened
   c. Movement of downed wires by wind or rescue work may burn other wires down
   d. Wires on ground may burn off
      (1) Ends may curl up
      (2) Roll along the ground
      (3) May cause injury to someone
   e. Burns, electric shock or eye injuries from flashes may occur
   f. EXPLAIN how low voltage can also kill
   g. Car or truck may be insulated by rubber tires
   h. Contact with car could cause death
      (1) Keep victims in car
      (2) If they get out, they must jump clear of car
   i. EXPLAIN the automatic circuit breaker
   j. Ground may be energized

   EXPLAIN and DEMONSTRATE a method of handling energized wires as on p. 253, Fire Service Training (text).
   EXPLAIN how to remove victim from wires.

K. RADIATION RESCUE

1. Remove Victim With as Little Contact as Possible
2. Give a Minimum Amount of First Aid, Call Doctor

Instructor's Notes

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 16 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW UP:

REVIEW Assignment Sheet No. 16, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #17

EXPOSURES AND CONFINEMENT

OBJECTIVES:

1. To impress upon the learner the importance of preventing the spread of fire from its place of origin.
2. To acquaint the learner with the methods by which heat may be transmitted.
3. To acquaint the learner with the avenues by which fire may travel.
4. To acquaint the learner with the knowledge and methods used to confine fire to its place of origin.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser
2. Sketch or chart of a building or a gravity furnace showing heat transmission
3. Sketch or chart of buildings of different heights used to show how fire can spread from building to building
4. Small iron rod to illustrate how heat conducts through metal.
5. Candle and matches

REFERENCE:

Fire Service Training (text), Chapter 17, pp. 255-261.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Every fire presents an exposure and a confinement problem. Exposure in fire service terminology means, any building or material that is likely to become involved, either directly or indirectly, with the existing fire. Exposure hazards are divided into two categories, interior and exterior.

To perform an effective job of covering exposures one must know how heat is transmitted and the avenues fire may travel within a building. One must also learn the different types of built-in protective devices and how they function.

The confinement and extinguishment of a fire at its place of origin is the best type of exposure protection.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. EXPOSURES

1. EXPLAIN - The study of exposures covers the operation that is necessary to prevent the extension of fire to other parts of the involved building or other buildings and property
2. Fire spreads by heat transmission
3. Other factors that determine exposure hazard:
    - a. Delay in the discovery or reporting of the fire
    - b. Weather conditions: humid, dry, wind direction, velocity, etc. Atmospheric temperature: hot, cold
    - c. Combustibility of materials burning
    - d. Type of construction of involved building
    - e. Size of the structure
    - f. Size of the fire
    - g. Degree of the exposure

B. HOW HEAT MAY BE TRANSMITTED

1. EXPLAIN - That direct contact with flame is not the only way by which fire may spread
2. Three methods by which heat may be transmitted in sufficient intensity to cause fire in exposed combustible materials, namely:

BUILD UP the following on the chalkboard as each is DISCUSSED.

HEAT MAY BE TRANSMITTED BY:

1. Conduction
2. Radiation
3. Convection

3. Conduction
    - a. Conduction - "The transmission of heat within a material or from one material to another which is in contact with it, without any visible motion of the material"
        - (1) Conduction of heat to combustible material through thin brick walls
        - (2) Pipes, ducts, or drive shafts that may extend through walls

          Use small iron rod heated by candle to DEMONSTRATE how heat is conducted through metal.
        - (3) Upper floors through steel I beams, iron fire doors, etc.

Instructor's Notes

(4) Material should be stored in a manner that heat from conduction can be avoided

REFER learners to heat conductivity table of various metals and materials on p. 255, Fire Service Training (text), and DISCUSS. Silver is almost four times as good a conductor as lead. Note the poor conductors make good insulators against heat or cold. Practically all liquids are poor conductors of heat.

4. Radiation
    a. Radiation - "The transmission of heat from a heated object to a colder one by heat waves"
    b. Waves radiate in straight lines in all directions from the heated body
        (1) Sun is a source of radiant heat
        (2) Fire is a source of radiant heat
    c. When combustible material is exposed to radiant heat and heat is at or above kindling temperature of material, fire will result
    d. Prevention of spread of fire from radiation can be accomplished with fire streams
        (1) Water absorbs the radiant heat
        (2) Furnishes the exposed material with a protective covering that must be vaporized before heat can again attack
    e. Highly polished opaque surfaces will reflect radiant heat, such as glazed ceramic tile
    f. Transparent and porous materials will absorb radiant heat allowing very little to transmit through them
5. Convection
    a. Convection - "The transmission of heat by the movement of heated gases or liquids"
    b. Most common forms are the passage of heated gases:
        (1) To upper floors of buildings from fire on the lower floors
        (2) From the fire building to another building
    c. Gases are driven off from the combustible material due to heat from fire but will not ignite due to lack of sufficient oxygen
        (1) EXPLAIN - All gases expand 1/492 in volume for each degree (F) of heat added
            (a) If the heat attained at all fires can be assumed to be near 1,800° F., all the various gases given off would be heated to the same temperature

Instructor's Notes

(b) The gases, having expanded to about four times their original volume, become much lighter than the surrounding air, creating currents and pressure

(c) Therefore, they rise and spread in all directions

d. Expanded gases will rise vertically through all openings that will permit passage

(1) Such as stairways, elevator shafts, dumb waiters, unstopped studding spaces, chutes, pipe holes, etc.

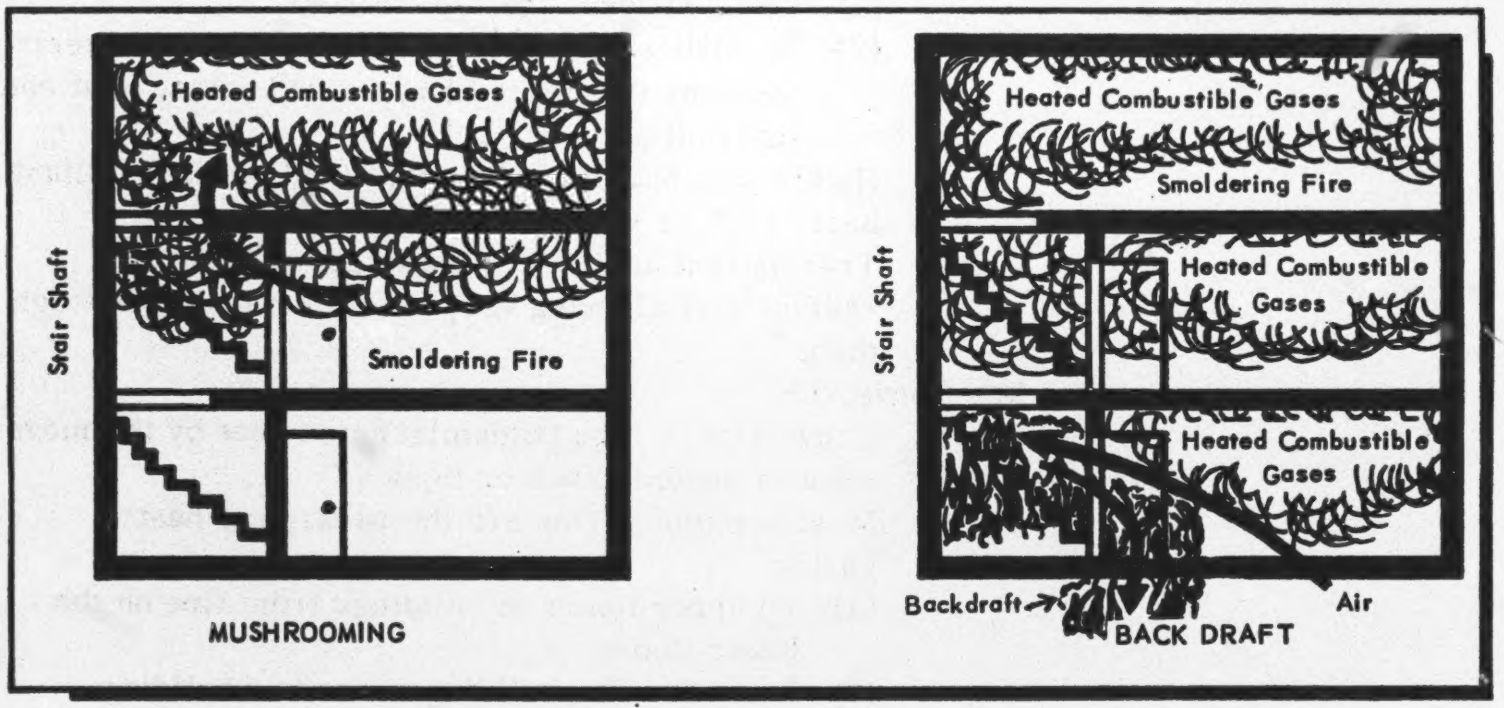
(2) They will then build downward or spread horizontally

e. Admission of air containing oxygen would cause heated gases to burn and might cause:

(1) Mushrooming of fire

(2) Backdraft

PLACE following drawing on chalkboard and DISCUSS.


Heated Combustible Gases
Stair Shaft
Smoldering Fire
Heated Combustible Gases
Smoldering Fire
Stair Shaft
Heated Combustible Gases
Heated Combustible Gases
Backdraft
Air

MUSHROOMING

BACK DRAFT

f. During large fires, buildings several hundred feet away may be ignited by burning embers carried upward in a surge of convected heat and carried by the wind to the other combustible materials

CITE the East Ohio Gas Company fire that occurred in Cleveland, Ohio as an example.

(1) The function of a gravity furnace is an example of how heat is transmitted by conduction, radiation and convection:

Instructor's Notes

- (a) The fire in the cast iron bowl creates the heat that conducts through the bowl
- (b) The conducted heat radiates from the bowl and heats the air between the outer jacket and the bowl
- (c) The heated air expands and is carried upward to outlet registers by convected currents
- (d) The heated air will rise to the upper level of the room
- (e) As the air is cooled, it will contract and travel to the lower levels into the cold air duct and be returned to the furnace to be reheated

6. How Fire May Extend
   - a. All combustible material that may be in danger of catching fire from the original fire is an exposure
   - b. It is therefore important for every fireman to know how fires extend:
     - (1) Room to room on the same floor - interior exposure
       - (a) Through unprotected horizontal openings, such as are provided for doors, transoms, interior windows, hallways, pipeways, and beltways
       - (b) By convection of heated air, smoke and gases
       - (c) By explosion or flash burning of smoke and gases
       - (d) By fire entering concealed spaces and extending to other rooms
       - (e) By conduction of heat through such mediums as unprotected steel beams, pipes and air ducts which extend from the involved room to other rooms
       - (f) By ignition of combustible materials which are too close to walls or unprotected openings
       - (g) By burning through interior walls
     - (2) From floor to floor in the upward extension - interior exposure
       - (a) Through unprotected floor openings such as are provided for stairways, elevator shafts, ventilation shafts, lightwells, dumb-waiter shafts and beltways
       - (b) By convection of heated air, smoke and gases

Instructor's Notes

- (c) By explosion or flash burning of smoke and gases
- (d) By conduction of heat through such mediums as unprotected steel supports, pipes and air ducts which extend from floor to floor
- (e) Through partitions or concealed spaces which extend to upper floors not having fire stops
- (f) By burning through exterior windows and entering upper floors through unprotected openings
- (g) By ignition of combustible materials which are too close to unprotected openings

(3) From floor to floor in downard extension - interior exposure

- (a) By explosion or flash burning of smoke and gases
- (b) By "mushrooming" of heated air, smoke and gases to lower floor
- (c) By sparks and burning material falling through unprotected openings such as those provided for stairways, elevator shafts, ventilation shafts, light-wells, dumb-waiter shafts, beltways, and wall partitions
- (d) By burning down the inside of unprotected shafts
- (e) By conduction of heat through such mediums as unprotected steel supports, pipes, and air ducts which may extend from floor to floor
- (f) By collapse of roof or floors
- (g) By burning through floors

(4) From building to adjoining building - exterior exposure

- (a) Through unprotected wall openings, such as doors, windows, holes, etc.
- (b) From cornice to cornice
- (c) By flashing over or around parapets and igniting roofs, etc.
- (d) Through falling walls, floors, or roofs, causing the scattering of burning materials
- (e) Through holes in walls where timbers have been built in
- (f) Because of failure of protective devices, such as fire doors, walls, etc.

Instructor's Notes

(5) From building to a building not adjoining - exterior exposure
- (a) Through combustible exterior walls, etc.
- (b) From overhanging roofs
- (c) By flying embers and brands
- (d) Through unprotected wall openings
- (e) By transmission of heat through plain or wired glass, iron doors, etc.
- (f) By convection of superheated air, smoke and gases

C. HOW TO PREVENT THE EXTENSION OF FIRE

1. By quick extinguishment of the fire before the heat generated can be transmitted to exposed combustible materials
2. By having sufficient manpower and apparatus on the initial response
3. Proper distribution of men with hose lines to cover the exposures and extinguish the original fire
4. Where no other source of water is available other than booster supply, the "wetting down" of surrounding buildings is necessary to prevent the spread of fire from building to building

D. EXPOSURE PROTECTION

1. The type of construction and the many built-in protective devices will afford good exposure protection and prevent the spread of fire
   - a. Some of the devices provide automatic protection when needed
     - (1) They must be properly maintained and in operation at all times
2. Some of the protection methods are listed as follows:
   - a. Fire resistive construction
     - (1) Recent formulated and passed building codes, incorporating three basic features designed to limit the spread of fire are:
       - (a) Materials used in construction be of a noncombustible nature, thus preventing the spread of fire
       - (b) Partitions, doors, stair wells, elevator shafts and any other openings in the building be so constructed and protected to prevent the natural tendency of fire to spread upward

Instructor's Notes

- (c) All walls be constructed of fire resistant materials and all openings through them be so protected to prevent the horizontal travel of fire
- (2) Laws allowing proper enforcement of these building codes will help prevent unnecessary loss from from fire

b. Incombustible solid walls
- (1) Walls of sufficient thickness with no unprotected openings and constructed of fire resistant materials
  - (a) Provide the best possible protection against fire spread

c. Fire doors
- (1) Used where buildings with fire walls are divided into sections and have openings in these sections
- (2) May be manually operated or equipped with fusible link for automatic protection
- (3) Must be properly maintained and never blocked open

d. Vertical protection
- (1) Enclosed stairways, elevator shafts, dumb waiters, and utility ducts provide good protection against the rise of convected heat
- (2) Studding should be "fire stopped"

REFER learners to Fig. 1, p. 259, Fire Service Training (text).

e. Sprinklers
- (1) Excellent for extinguishing fires in the early stage
- (2) On the job at all times and considered the best auxiliary aid to fire departments
- (3) To be efficient, all areas must be protected
  - (a) System requires supervision and must be in working order at all times

f. Window protection
- (1) Fire shutters
  - (a) Used on windows facing alleys or narrow streets
  - (b) Swinging type operates manually
  - (c) Rolling steel type operates automatically with a fusible link
  - (d) Both types will transmit heat and combustible material should not be stored too near them
  - (e) Very seldom used in modern construction, but may be incorporated on some buildings

Instructor's Notes

- (2) Wired glass
  - (a) Offers good protection against exposures
  - (b) Will remain in place when hit by fire stream
  - (c) Does not provide perfect protection
  - (d) Will transmit heat and at high temperatures, above 1,600° F., will fuse and melt
- g. Water curtain
  - (1) Generally used by having a sprinkler head extended to the outside and over each window
  - (2) Heat will fuse the link permitting water to flow and cover the entire window opening
  - (3) Sometimes a perforated pipe is installed on the exposed side of the building just below the roof level
    - (a) A dry type and operated manually by opening a valve

E. COVERING EXPOSURES

1. STATE that covering of exposures consists of completely surrounding the fire
   - a. So that it will be checked at each possible avenue of extension
2. Important items to be considered in covering exposures:
   - a. Determine the most dangerous direction of extension
     - (1) Take immediate action to halt the progress of the fire in that direction
   - b. If burning building and exposed buildings are equipped with air conditioning or any forced draft systems for heating, cooling or ventilating shut down such systems at once
     - (1) It may be necessary to pull the master power switch
   - c. Make use of all permanent and built-in protection
     - (1) If building is sprinklered, it may be necessary to lay supply lines to the outside siamese connections
   - d. If possible, completely surround the fire with streams of sufficient size
     - (1) Position streams so as to block each avenue of extension
     - (2) Utilize ladder nozzles, fog heads and heavy appliances as water curtains, etc.
   - e. Endeavor to prevent high tension lines from falling and endangering life and property
     - (1) Protect poles with fire streams until wires can be cut or control switches pulled

Instructor's Notes

f. Police streets and highways leading to fire to provide right of way for additional apparatus
g. Keep a check on fire walls and combustible material within exposed building
h. If necessary, ventilate exposed building to reduce temperatures or to take care of smoke seepage
i. Do not neglect salvage work in exposed building
j. Always lay in protecting line
k. Note direction and velocity of wind
l. Check all possible places where fire, smoke, and heat can enter
    (1) Continue checking until fire is extinguished
m. Thoroughly inspect buildings at regular intervals
    (1) Adopt a pre-determined method to follow should buildings become involved in fire

F. CONFINEMENT
1. DEFINITION - "Confinement is that action which is necessary to contain the fire in the smallest possible area"
2. Follow procedure for covering of exposures
3. Make sure that fire doors and other protective devices are closed
    a. To prevent the fire from extending to uninvolved sections of the building
    b. Ordinary doors offer much protection against the extension of fire if closed
4. Protect all avenues of extension with hose streams when necessary
    a. Such as stairways, elevators, ventilators and other vertical shafts
5. Locate the main body of fire and determine the area involved
    a. Attack the main body of fire
        (1) Being careful not to force flames and heat into uninvolved parts of the building
6. Advance information of the building is invaluable to firemen
    a. When they are called upon to confine and extinguish a fire
    b. It enables them to have a mental picture of:
        (1) Type of construction
        (2) Physical layout (height, size, etc.)
        (3) Nature of the occupancy
        (4) Built-in protective devices, sprinklers, standpipes, firedoors, etc.

Instructor's Notes

(5) Location of gas and power shut offs

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 17 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 17, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #18

FIRE EXTINGUISHMENT

OBJECTIVES:

1. To understand the theory of the three methods of fire extinguishment used in the process of fire fighting.
2. To learn the application, use, and effects of various fire extinguishing media.
3. To become familiar with practices used in the extinguishment of various types of fires

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Table demonstration to include various flammable liquids, combustible materials, candles, beakers, covers, etc.
3. Fire triangle mock-up (if available)
4. Dictionary of Building Terms (provided by your Fire Coordinator)

REFERENCE:

Fire Service Training (text), Chapter 18, pp. 262-285.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

The actual practice involved in the extinguishment of fires, includes all the various steps taken from the time the fire department arrives on the scene until the fire is extinguished. Because of the many circumstances involved in the operation, all phases of the problem must receive attention. The possibility of human or mechanical failure makes it imperative not to place sole reliance on any one method. Knowing how to secure the greatest practical measure of safety and fire fighting skill at the fire scene requires knowledge, experience, and the exercising of good judgment in each fire problem.

STEP II - PRESENTING THE LESSON:

A. THEORY OF FIRE EXTINGUISHMENT
STATE - as explained previously in the Chemistry of Fire chapter, combustion or burning is defined as - "a chemical process accompanied by the evolution of heat"

Instructor's Notes

1. Three essentials necessary to have or to support combustion are:
   a. Fuel
   b. Oxygen
   c. Heat
2. If a fire is to be extinguished, one of three things must be done:
   a. Remove the fuel
   b. Reduce the oxygen supply, by excluding or exhausting it
   c. Eliminate the heat, by cooling the burning material

   ***ILLUSTRATE** further by placing on chalkboard or using a fire triangle mock-up. **REMOVE** or **BLANK OUT** each essential while explaining.*

B. THREE METHODS OF EXTINGUISHING FIRES
1. Remove the Fuel
   a. EXPLAIN that in a strict sense such procedure is not the true essence of this method. There are however, instances when this can be done, such as:
      (1) Scattering logs or embers in a bonfire
      (2) Cutting down brush and trees in a forest fire
      (3) Bulldozing a fire stop in prairie fire
      (4) Shutting off the gas supply
      (5) Draining oil from storage tanks
   b. Modern fire fighting tactics isolate or remove fuel by:
      (1) Covering exposures with water curtains or spray streams
      (2) Removing combustibles stored against protected walls or openings
      (3) Removing burning materials from building
2. Reduce the Oxygen Supply
   a. Fire fighting practices involve the use of extinguishing agents when applied to burning materials create a blanketing or smothering effect which reduces or excludes the supply of oxygen necessary to support combustion
      (1) Using inert chemicals or gases
         (a) Carbon dioxide
         (b) Dry chemical
         (c) Foam
         (d) Vaporizing liquid
      (2) Using fog or spray streams
         (a) Converting water into steam, thereby increasing its volume 1,650 times, and displacing or excluding the oxygen

Instructor's Notes

- (3) Use of steam hose lines
  - (a) Primarily used on ships to protect combustible cargoes in confined areas or holds
  - (b) Hazard from burns
  - (c) Large steam supply must be available
  - (d) Not practical in every day fire fighting

3. Eliminate the Heat
   - a. In this method the concern is the removal of the heat from a fire faster than it can be generated
   - b. Once the temperature of the burning material has been reduced or cooled below its ignition point, self sustained combustion cannot occur, and the material will cease to burn
   - c. Fortunately, the fire service has an extinguishing agent which is capable of providing such a method or process
   - d. The agent is water, having the following characteristics:
     - (1) Its abundance
     - (2) Low cost
     - (3) Ease of manipulation
     - (4) Requires more heat to raise its temperature than an equal weight of any other liquid or solid
     - (5) Consequently its heat absorption quality is an important factor in fire extinguishment
   - e. How water should be used
     - (1) Water spray
       - (a) Smaller particles absorb more heat
       - (b) Turns more quickly into steam, thereby exerting maximum cooling
       - (c) Smaller quantity of water is used
     - (2) Water applied from a solid stream is merely heated, and only a small part is turned into steam

C. FIRE EXTINGUISHING AGENTS

1. All ordinary material requires oxygen to maintain combustion
   - a. Therefore, if air can be kept away from the material it will not burn
   - b. Also, after ignition, if air can be excluded, the burning will stop
   - c. However, if the material remains heated above its ignition temperature, or, if there are hot coals or embers, re-ignition will occur whenever sufficient air is allowed to reach them

Instructor's Notes

2. Air exclusion as a means of extinguishment is most successful with oils, fats, and gases which do not leave hot embers
3. There are two general methods of extinguishment by air exclusion:
    a. Mechanical means
        (1) Covers
            (a) Diptanks, dry cleaning machines, kettles,
            (b) Manual or automatic operation
        (2) Blankets
            (a) Smother fire when clothing is afire
            (b) Abestos blankets in industry
    b. Use of inert gases or chemicals
        (1) Heavier than air
        (2) More efficient in tanks or confined areas
        (3) Open areas will induce draft and limit effectiveness
        (4) Carbon dioxide, carbon tetrachloride, chlorobromomethane, dry powder
4. Combination of cover and inert effect is application of foam
    a. Chemicals create the bubbles which cling together and contain the carbon dioxide gas
    b. May be used on free burning materials if they can be completely covered
5. Complete exclusion of air is not necessary to extinguish a fire
    a. Oxygen supply reduced from 21% to less than 16%
    b. Will smolder at less than 16% even though flame is extinguished
    c. Applications of carbon dioxide serve to dilute air
6. Water is the best cooling agent
    a. Can be forced through pipes and hoses
    b. Can be stored indefinitely, when protected against freezing
    c. Can be applied by:
        (1) Hand
        (2) Pressure
        (3) Gravity
    d. Applied from hose lines
        (1) Small lines on minor fires
        (2) Large lines on major fires for penetration
    e. If used properly can be applied to almost all classes of fires
    f. Adapted to automatic control

Instructor's Notes

- (1) Sprinkler systems
- g. No specific method for applying water
    - (1) Direct application
    - (2) Indirect application
- h. Best results are obtained in using water when:
    - (1) All or most is turned into steam
    - (2) Application is made near the fire
    - (3) Proper type and size of nozzle is used
    - (4) Proper operating pressure is maintained
- i. Must be applied with restriction, as excessive amount will:
    - (1) Damage materials involved in fire
    - (2) Damage materials not involved in fire

D. FIRE EXTINGUISHING PRACTICES

- 1. There are no set rules for fire extinguishment
- 2. Delay of fire discovery, transmission of alarm, response of apparatus, etc. may mean the difference between a small or large fire
- 3. Building construction, combustibility and amount of contents, exposures involved, and various other factors determine the method and procedure best suited to control the fire
- 4. However, a number of good practices which, when coupled with good judgment, can be used at most fires
    - a. Some of these are:

***REFER** learners to pp. 264-265, Fire Service Training (text), **DISCUSS** the 31 items listed. **ASK** for questions from class pertinent to items which may need further explanation.*

E. BUILDING FIRES IN GENERAL

- 1. Conditions which are general at all building fires, relating to successful extinguishment are:
    - a. Knowledge of chemistry of fire
    - b. Potential spread of fire
    - c. Application of inspection results for:
        - (1) Means of entry
        - (2) Ventilation procedures
        - (3) Location of horizontal and vertical openings
        - (4) Nature and location of stock
        - (5) Knowledge of changes or unusual conditions
        - (6) Source and location of water supply
    - d. Responding and additional fire apparatus
    - e. Extent of fire upon arrival
    - f. Small fire may permit close at hand fire fighting

Instructor's Notes

g. Large fire may have to be attacked first from the outside
h. Selection of hose lines and nozzles
i. Avoid excessive water damage
j. Entry into building for total extinguishment
k. Mobility of fire streams
l. Hazards involved during and after fire

2. Effects of Burning
   a. Duration and intensity causes metal structural members to expand
   b. Application of water will cause contraction
   c. Combination of a and b above, may cause warping of structural members and make entry hazardous
   d. Potential hazard is relative to construction
      (1) Where no fire protection for structural members exists
      (2) Where fire protection for structural members does exist
   e. Intensity of heat generated is dependent on the amount and flammability involved
3. Weight of Contents
   a. Original construction of building is designed to carry intended weight for a specific occupancy, plus a margin of safety
   b. Change of occupancy or addition of heavy machinery or stock reduces safety factor
   c. Excessive amounts of water applied to water absorbent stock will increase weight
   d. Accumulative depth of water on floors will add weight, if:
      (1) Floors are not scuppered or drained
      (2) Drains are clogged or blocked
   e. Judgment should be exercised upon entry if such conditions exist

F. FIRE STREAMS

1. Solid Streams
   a. Water must be applied to reduce heat faster than the heat is generated
   b. If responding apparatus cannot supply adequate fire streams, additional equipment should be summoned
   c. Time factor involved when apparatus must respond from long distances
   d. Quick decisions must be made for best results
   e. Number of hose streams used is dependent on:

(1) Ease of bringing lines into operation
(2) Avenues of application
    (a) One, two, three, or four sides of building
(3) Size of fire
(4) Readiness and source of water supply
    (a) Hydrants
    (b) Lakes, ponds, rivers
    (c) Storage tanks
    (d) Transported

f. Penetration into building is important
    (1) Water must reach burning material
    (2) Solid stream must be:
        (a) Large enough to hold together
        (b) Have proper operating pressure to overcome resistance from air pressure and must carry through the heat field to burning material without completely vaporizing

g. The larger the fire, the greater quantity of water is needed for proper cooling effect

h. One large stream may be better than an equal volume of water from several small streams
EXPLAIN in terms of the above items.

i. It is better to use streams that can be reduced in size, than to use small streams that are not effective

2. Spray Streams
    a. Extinguishment is accomplished with a smaller amount of water
    b. Used as water curtain:
        (1) In updraft to reduce heat for closer approach for extinguishment in out of the way places
        (2) To shield firemen from heat
    c. Can be used for different operating nozzle pressures:
        (1) Normal low pressure nozzles for ordinary fire department use
        (2) Special high pressure nozzles operated from high pressure fire apparatus

G. SUGGESTED PRACTICES FOR FIRE EXTINGUISHMENT IN VARIOUS TYPES OF FIRES

1. Single Room
    a. Small fire
        (1) Attack close at hand using minimum quantity of fire extinguishing agent
            (a) Portable extinguisher
            (b) Booster line

Instructor's Notes

b. Entire room involved using spray stream
  (1) Prevent vertical or horizontal spread
  (2) Apply water quickly
  (3) Only one opening available
    (a) Direct nozzles through opening
    (b) Grip hose line one and one half feet back from end of nozzle
    (c) With both hands, swing nozzle in circular motion directing nozzle toward ceiling
    (d) This will obtain better distribution, coverage and cooling effects
  (4) More than one opening available
    (a) Apply water from first opening for 15 to 20 seconds
    (b) Move to second opening and apply in same fashion
    (c) Continue moving to other locations if available and repeat operation
  (5) Judge effects by observing following sequence:
    (a) Expulsion of smoke
    (b) Mixture of smoke and steam
    (c) Steam with little or no smoke
  (6) Inject water until volume of steam has decreased to noticeable extent
  (7) Indicates fire is extinguished and heat reduced
  (8) Stop application of water
  (9) Nozzleman should keep low or be protected from escaping hot smoke and steam
  (10) Wait 15 to 30 seconds before entering for further extinguishing, to permit better visibility and cooling

c. Entire room involved using solid stream
  (1) Direct stream at ceiling
    (a) For deflection over burning material
    (b) Breaks up stream in smaller particles for better heat absorption and subsequent cooling

d. Use only enough water to stop progress of fire and gain control

e. Employ ventilation practices

f. Check for potential vertical or horizontal extension of fire

g. Overhaul

2. More Than One Room

a. Use same procedure as outlined in extinguishing single room fire
  (1) Move from room to room

Instructor's Notes

(2) Results are similar
  (a) Heat and fire are lessened
  (b) Under control more quickly
  (c) Entry for final extinguishment easier
(3) Difficult to extinguish fire in two or more rooms from one location
(4) Heavy water damage results when applying water from one location
(5) When two or more lines are available, use each line for extinguishment in separate rooms

3. Partition Fires

a. Two general categories
(1) Starting within partition
  (a) Short circuit in wiring
  (b) Heat conduction
(2) Entering by means of -
  (a) Spread of fire from below
  (b) Hot embers dropping from fire above

Discussion will pertain only to a fire within a partition, not the origin or source.

b. General information about partition fires
(1) Offer chance for fire to spread
(2) Often accompany basement fires
(3) Proper fire stopping can control
(4) Use of incombustible or less combustible material in partition construction is factor in controlling spread
(5) Holes made in partitions by workmen will allow fire to enter even though fire stopped
(6) A warm partition is not always an indication there is a fire within, as:
  (a) Heat could be present from fire below
  (b) Lack of oxygen can prevent burning
(7) Needless opening of partitions indicates poor fire department operation, when:
  (a) Fire did not reach involved area
  (b) Unnecessary damage increases fire loss
(8) Reluctance to opening partition could:
  (a) Cause fire to spread
  (b) Cause extensive fire damage instead of small repairs to area involved
(9) Responsibility for opening partition rests with officer, to eliminate:
  (a) Possibility of fire
  (b) Probability of fire rekindling at the scene or after return to quarters

Instructor's Notes

c. How to determine fire within partition
  (1) TOUCH - feeling with back of hand for hot spots
  (2) SIGHT:
    (a) Discolorations on wall paper or plaster
    (b) Evidence of blistering on painted surfaces
  (3) HEARING - listening for the rumbling or crackling sounds of burning

d. Where partition opening should be made
  (1) Location involving least damage and repair
  (2) Tile in bathroom vs. plaster in bedroom
  (3) Ceiling in hallway vs. ceiling in room with furniture
  (4) Removal of baseboard or molding may reveal fire or fire travel
    (a) Do carefully to permit replacement

e. How partition opening should be made
  (1) Careful and efficient manner
  (2) Small opening can be enlarged as needed
  (3) Less damage will require smaller cost to repair

f. Extinguishment of partition fires
  (1) Do not open partition until charged hose line is in readiness
  (2) Opening will admit oxygen, may cause:
    (a) "Blow-out"
    (b) Intensify burning
    (c) Increase volume of fire
  (3) Insert small stream, and direct upward and downard
  (4) Creation of steam will cool and smother fire
  (5) Enlarge opening for further examination
  (6) Apply water as needed, to minimize water damage

g. Overhauling
  (1) Dry and fuzzy surfaces will hold embers and sparks, which may rekindle fire
  (2) Water application alone will not guarantee total extinguishment
  (3) Examine and overhaul area carefully and completely before return to quarters
  (4) When in doubt, leave detail with charged line or extinguisher, and adequate tools until potential danger is over

4. Attic Fires

a. Procedure varies in accordance with construction
  (1) No interior finish or flooring

Instructor's Notes

- (2) Finished and partitioned

b. Knowledge of construction details will facilitate means of entry and extinguishment

Pass out Dictionary of Building Terms and DISCUSS (Provided by Fire Service Training Coordinators).

c. Operate from inside to avoid:
   - (1) Improper application of fire streams
   - (2) Excessive water damage

d. First line should be taken up inside stairway to fire area

e. Entry should be made through:
   - (1) Trap doors on scuttles when available
   - (2) Ceiling below when openings are not available
     - (a) Opening in hallway or closet in preference to furnished room, will result in less damage
     - (b) Openings should be made in neat and workmanlike manner
   - (3) Roof when necessary
     - (a) Cut between joists or rafters
     - (b) Avoid unnecessary damage

f. Location of fire may be difficult because of -
   - (1) Rising and accumulation of heat, smoke, and gases to this area
   - (2) Mushrooming of intense heat and smoke

g. Ventilation
   - (1) Open windows from outside
   - (2) Open scuttles or trap doors
   - (3) Open roof

h. Never start ventilation unless charged hose lines are in readiness

i. Small streams are usually effective unless fire is large and gained headway

j. Solid streams should be directed at ceiling for deflection and better coverage by sprinkling effect

k. Fog nozzles will obtain maximum extinguishing effect
   - (1) Heat absorption potential
   - (2) Rapid conversion to steam
   - (3) Faster cooling and smothering
   - (4) Less water damage

l. Precautions and procedures
   - (1) Do not apply water until fire is located
   - (2) Apply water, shut-off, check results
   - (3) Extinguish same as single room fires

Instructor's Notes

(4) Avoid excessive use of water
(5) Use salvage covers to protect rooms and floors below
(6) Ceilings will hold water for a short time, and permit salvage operations below

5. Basement Fires
  a. Usually well advanced before discovery
  b. Lack of oxygen results in:
    (1) Slow burning
    (2) Large amounts of smoke and gases
  c. Always wear self-contained breathing apparatus
  d. Officers should take precautions to:
    (1) Account for personnel in area
      (a) Possibility of being overcome and lose consciousness
    (2) Man hose lines with at least two men
  e. Be aware that heat, smoke, and heated gases rise
  f. Check for extension of fire to upper floors through all vertical openings
  g. Ventilation should be started at roof or over stairways
  h. Greatest responsibility is preventing spread of fire
  i. Extinguishment of fire in basement may be secondary
  j. Extinguishment practices are similar to attic fires in terms of
    (1) Using fog nozzles to obtain maximum results by indirect application of water
  k. Where fire has not gained too much headway:
    (1) Bring lines directly into basements by means of stairway or basement windows
  l. Where it is indicated that fire has spread:
    (1) Lay additional lines to head off
    (2) If area is large, fire may be attacked from front and rear
      (a) Exercise caution so as not to force heat and smoke against advancing crews
    (3) Employ cellar pipes and distributing nozzles if direct attack is impossible:
      (a) Through holes in floor or basement windows
      (b) Use horizontal and vertical motion when using
      (c) Use large fog head nozzles if available
  m. Knowledge of basement arrangements, contents, partitions, etc. will aid fire fighting procedure
  n. If heat appears to be building up on the upper floors, building must be ventilated

Instructor's Notes

(1) Start at roof
(2) Work down to street floor
(3) This will prevent backdraft

o. If fire is making headway, set up lines to:
(1) Cover firemen if forced from basement
(2) Cover upward extension
(3) Cover exposures
(4) Use large streams with fog nozzles to cool area

p. Be on the alert for potential back draft or explosion by observing openings around doors, windows, and cracks for:
(1) Pressure pushing out smoke
(2) Pulsating pattern of smoke
(3) Color of smoke

q. Basement ventilation problems and procedures
(1) Windows allow passage of air both in and out
(2) Stairways are good only when leading directly to outside
(3) Opening both windows and stairway doors may help
(4) Smoke ejectors should be used if available
(5) Heaviness of outside air coming into area creates better breathing conditions at floor level to knee height

r. Factors to consider in water application
(1) Damage already incurred to stock by heat and smoke
(2) Physical conditions and hazards facing firemen
(3) Necessity of further damage to stock by water application to cool area for entry
(4) Concentrate on source of fire to eliminate potential backdraft
(5) Water damage to upper floors and downward seepage less likely
(6) Some water damage is preferable compared to potential loss of entire building

s. Where sprinkler protection is installed
(1) Pump into system if necessary
(2) Make certain sprinklers are operating
(3) Assures water application on fire, when:
    (a) There might be delay in laying hose lines
    (b) Sufficient hose lines are not available

t. Avoid careless or promiscuous use of water

6. Apartment, Hotel, Institutional Fires
a. Common factor is life hazard

Instructor's Notes

b. Life saving precedes fire fighting

c. Officer responsibilities are:
  (1) Immediate size-up
  (2) Determine plan of action
  (3) Direct men where most needed
  (4) Position apparatus for efficient operation
  (5) Decide necessity for additional help
  (6) Advisable to call for extra help, even though not used

d. Size-up -
  (1) Fit situation at hand, because buildings differ
    (a) Height
    (b) Type of construction
    (c) Access to inside and outside stairways
    (d) Extent of fire
    (e) Vertical shafts
    (f) People in building
    (g) Fire spread
    (h) Time of day or night

e. Rescue
  (1) All personnel and equipment must work in this direction
    (a) Evacuation by stairways
    (b) Evacuation using ladder equipment
    (c) Life nets
    (d) Use of gas masks

f. Extinguishment
  (1) Small lines inside
  (2) Large lines outside
  (3) Heavy streams

g. Simultaneous rescue and extinguishment
  (1) Correlate operations
  (2) Preplanning necessary to cover:
    (a) Responsibilities of personnel
    (b) Apparatus assignments
    (c) Eliminate confusion

h. General procedures
  (1) First company in:
    (a) Get line inside of building to cover exposures, to protect stairways for rescue, and cover vertical openings
  (2) Succeeding companies:
    (a) Attack fire
    (b) Cover exposures
    (c) Prevent extension of fire

Instructor's Notes

- i. Chief officer
  - (1) Direct rescue and fire fighting operations
  - (2) Observe, direct, control all operations
  - (3) Avoid concentration on single operations
- 7. Mercantile Fires
  - a. Individual retail and wholesale stores
  - b. Shopping centers
    - (1) Large areas
    - (2) Delayed alarms
    - (3) Extent of fires
    - (4) Availability of water
  - c. Causes of fire
    - (1) Heating equipment
    - (2) Careless smoking
    - (3) Motors
    - (4) Rubbish
  - d. Extinguishment
    - (1) Confinement
      - (a) Nature of adjacent occupancies
      - (b) Nature of partition construction
      - (c) Lack of fire walls
      - (d) Extension through cocklofts
    - (2) Inadequate water supply
  - e. Living quarters above
    - (1) Life saving and evacuation is first
  - f. Windowless buildings
    - (1) Aggravates fire fighting problem
    - (2) Access openings as recommended in building codes
  - g. General problems and factors involved
    - (1) Availability of:
      - (a) Water
      - (b) Equipment
      - (c) Manpower
    - (2) Mutual aid response
    - (3) Fire inspection program
      - (a) Knowledge of building and contents
      - (b) Fire fighting procedure
      - (c) Operating procedure
    - (4) Handle each situation in accordance with the problem involved
  - h. Drug store fires
    - (1) Stock (drugs and chemicals)
    - (2) Storage and containers
    - (3) Use of hose streams

Instructor's Notes

- (a) Careful handling of straight streams
- (b) Fog streams advisable
- (4) Respiratory protection
- (5) Ventilation necessity

i. Hardware store fires
  - (1) Stock (chemicals, amunition, paints, flammable liquids, etc.)
  - (2) Potential flash fires from broken or ruptured flammable liquid containers
  - (3) Potential explosions
  - (4) Danger from exposed ammunition
  - (5) Decomposition of fertilizers
  - (6) Use of hose streams
    - (a) Careful handling of straight streams
    - (b) Fog streams advisable
  - (7) Use of extinguishing agents on small fires, such as:
    - (a) Foam
    - (b) Carbon dioxide
    - (c) Dry chemical
  - (8) Ventilation necessity
  - (9) Respiratory protection

8. Manufacturing, Commercial and Industrial Fires
  - a. Manufacturing or processing plants
  - b. Problems involved
    - (1) Large areas
    - (2) Inadequate construction
    - (3) Reaching seal of fire and application of fire streams
    - (4) Windowless buildings
    - (5) Water supply
    - (6) Alarm transmission
    - (7) Fire department response effected by:
      - (a) Fire department travel time and distance
      - (b) Road conditions
  - c. No specific method of operation
  - d. Handle each situation in accordance with the problem involved
  - e. Information relative to:
    - (1) Acids (nitric, sulphuric, perchloric)
      - (a) Can cause fire or explosion upon contact with water
    - (2) Oxidizing materials (nitrates, peroxides, chlorates, perchlorates)
      - (a) May be combustible or explosive, depending on conditions

Instructor's Notes

- (3) Unslaked lime
  - (a) Generates heat upon contact with water
- (4) Sodium
  - (a) Liberates hydrogen upon contact with water
- (5) Pyroxylin
  - (a) When new and clean, does not decompose at temperatures less than 200° F.
  - (b) When old, may decompose and ignite simultaneously
  - (c) Must be cooled below point of decomposition for extinguishment with large quantities of water
- (6) Acetylene
  - (a) Cylinders can explode from shock, if dropped or knocked over
  - (b) Use caution when directing hose streams
  - (c) General practice for escaping gas fires, let burn until flow can be stopped
  - (d) Keep surrounding area cool with water, to prevent ignition of combustible materials

f. General recommendations

- (1) Know amount and location of water supply
- (2) Limit hose streams in accordance with water supply
- (3) Use sprinkler systems when operable
- (4) Pump into sprinkler system when available
- (5) Do not rob sprinkler system of water to supply hose lines
- (6) Operate hose lines in accordance with need and demand
- (7) Protect exposures
- (8) Use protective clothing and respiratory protection when chemicals, smokes, and gases are involved

g. Value of fire inspection program

- (1) Knowledge of materials and processes involved
- (2) Aid in pre-planning in terms of:
  - (a) Before the fire
  - (b) During the fire
  - (c) After the fire
- (3) Cooperation between plant and fire department personnel relative to potential or existing fire hazards
- (4) Effects understanding of mutual problems and concern

9. Chimney Fires

Instructor's Notes

a. Result of deposits of products of combustion within the chimney
b. Not to be confused with fire resulting from defective chimney
c. Could be allowed to burn out, if:
   (1) Chimney was properly constructed
   (2) Chimney is in good condition
d. Precautions
   (1) Must not be treated lightly
   (2) Same apparatus and personnel response as any other building fire
   (3) Potential spread or extension can involve entire building
   (4) Time lost in obtaining help to control
e. Extinguishment procedures and practices
   (1) Danger from burning sparks or soot emitted
      (a) Concentrate efforts on protecting combustible roof or parts of building
      (b) Let soot burn itself out in chimney
      (c) Use ladders to gain access to roof
      (d) Provide charged booster line or extinguisher
      (e) Remove soot through cleanout door in base of chimney, using metal containers (Not recommended on oil burning equipment)
      (f) Check and inspect chimney from basement to roof
      (g) Examine exposed attic portion carefully. This is usually an indication of general chimney condition
      (h) Apply water through cleanout door
      (i) Rising steam and vapor will extinguish fire
      (j) Chemicals are not recommended for extinguishment or for removal of soot
      (k) Some soot removing compounds contain oxidizing agents, explosions have resulted
      (l) High temperature created by burning chemicals increases hazard
      (m) Exercise caution when placing ladders against chimney for safety of fireman

10. Flammable Liquid Bulk Storage Fires
   a. Cause serious fire fighting and conflagration problems, due to:
      (1) Potential explosion, boil over, tank rupture
      (2) Absence of proper diking and run-off facilities
   b. Confine fire to smallest possible area

Instructor's Notes

c. Initial hose streams should be used for cooling down purposes only
    (1) Water directed on burning tank snould be applied below the fire line
    (2) Water should not be applied into tank
d. Use fire streams to cool surrounding tanks to prevent ignition by radiated or convected heat
e. Where special extinguishing systems are installed, place in operation as quickly as possible, because:
    (1) Longer burning generates more heat
    (2) More heat creates air currents
        (a) Adds to fire and exposure control
f. Danger signs indicating:
    (1) Boil over
        (a) Color change - faint red to blood red to cherry red
    (2) Explosion or blow-off
        (a) Bright red to salmon
    (3) Collapse
        (a) Light yellow or white (1,800° F. to 2,200° F.)
    (4) Collapse of structural supports
        (a) Nature and condition of supports
g. Position of tank determines direction of expelling force when rupturing or exploding
    (1) Usually through top or end of tank
h. Position of fire fighting companies
    (1) On sides, never in line with ends
i. Foam equipment supply arrangements
    (1) With owners or operators
    (2) Adjoining fire departments
    (3) Local or nearby plants
j. Suggested fire department policies
    (1) Cooperate with local plants on problem
    (2) Make study of all available fire extinguishing media and equipment
    (3) Establish joint plan of operation
        (a) Arrangements for obtaining materials needed
        (b) Establish duties and responsibilities of those involved
    (4) Mutual understanding and agreement will eliminate confusion and conflict

11. Metal Fires
    a. All metals will burn under certain conditions
    b. To-day's new metals add to problem because of combustibility factor

Instructor's Notes

c. Characteristics and methods of extinguishment
  (1) Magnesium
    (a) Has a high burning temperature
    (b) Combines readily with oxygen
    (c) Decomposes water, liberating the hydrogen and oxygen
    (d) Large amounts of water necessary for cooling
    (e) Large amounts of metal create potential explosion hazard
    (f) Apply hose streams from safe distances, or from behind shelter
    (g) Spray application somewhat effective
    (h) Automatic sprinkler protection may not extinguish, but will afford protection for surrounding material and area
    (i) Burns more violently on concrete floor. Moisture provides reaction
    (j) Common inert gases, carbon dioxide and nitrogen, not effective for extinguishment
    (k) Carbon tetrachloride dangerous, as released chlorine combines readily with the magnesium and reacts violently in form of an explosion
    (l) Helium and argon are effective because they do not react with magnesium but are poor cooling agents and too expensive for general use
    (m) Sand, talcum, slag and similar fine substances have been used - Value limited because of possibility of contained oxygen and moisture reacting with magnesium. Cover protection not sufficient
    (n) Small fires extinguished with coal tar pitch, G-1 powder, or other inert non-caking powders. Latter can be applied by first aid appliances through a nozzle
  (2) Titanium, zirconium, hafnium, thorium and uranium
    (a) Titanium and zirconium used for large structural sections and special purposes
    (b) In large form, present no special hazard
    (c) In finely divided or powder form, all five present a greater fire hazard than magnesium and aluminium

Instructor's Notes

- (d) Common extinguishing agents should never be used
- (e) Common extinguishing agents should not be permitted in area where metals are
- (f) Limited to use of graphite, soda-ash, dry talc, dry sand, other special agents such as G-1 powder
- (g) Inert gases, nitrogen, helium, argon may be used if total confinement can be made
- (h) Uranium - U.S.A.E.C. recommends shoveling into drums of water, preferably done outside

(3) Aluminum, iron, steel and zinc
- (a) All have high ignition temperature
- (b) Not dangerous in large form
- (c) Potentially dangerous in chip, shaving, or powder form
- (d) Dry sand or other dry chemical compounds should be used
- (e) Isolate fire by surrounding with extinguishing agents
- (f) Dust should not be stirred or fanned into air

(4) Summary
- (a) Only a few specific standards for extinguishment
- (b) Lack of uniformity, resulting in baffling problems on pyrophoric metals
- (c) Much to learn about combustible metal fires
- (d) Recommend using information from N.F.P.A. and N.B.F.U. standards
- (e) Keep in contact with local industrial plants on problem
- (f) Prefire planning important
- (g) Mutual understanding of problems between plants and fire department will eliminate confusion and indecision at time of emergency

12. Motor Vehicle Fires
   a. Minor fires
      (1) Extinguish with booster line or portable extinguishers
         - (a) Raise hood for direct application
         - (b) Apply through louvers, vents, or other openings when hood cannot be raised, or until hood can be opened

Instructor's Notes

- (2) Check for leaking gasoline
- (3) Stop leak by:
  - (a) Pinching tube together behind leak
  - (b) Elevating above level of gas tank
- (4) Flush away gasoline
- (5) Use plenty of water when flushing gasoline into sewers
- (6) When large amounts of gasoline are involved, conduct explosimeter checks of nearby basements

b. Interior vehicle fires
- (1) Insert small lines with fog nozzles into interior
- (2) Remove smoldering upholstery when overhauling
- (3) Check and examine interior for smoldering fires

c. Closed vehicle fires
- (1) Check color and appearance of smoke
- (2) Use caution when opening to avoid explosion

d. Air suspension busses
- (1) Danger from collapse of rubber bellows
  - (a) Between wheels and body
  - (b) Underneath vehicle
- (2) Jack or block up body securely for underneath examination or extinguishment
  - (a) Use jack plates provided
  - (b) Block up under solid bulkhead
  - (c) Jacks may be used under engine supports
  - (d) Support body before jacking or blocking up
- (3) When engines are running:
  - (a) Operate emergency stop button
  - (b) If button is inoperable, inject CO_2 into air intake
  - (c) Do not insert other chemical extinguishing agents
- (4) To kill current in electrical system
  - (a) Loosen nut holding cables and disconnect
- (5) Danger from engine fans
  - (a) Open engine compartments carefully and check for rotation of fans
- (6) Rescue techniques
  - (a) Use windows when doors are inaccessible
  - (b) Force windows out by prying with large screw driver or pinch bar under metal frame of window
  - (c) Remove windshield and sky lights by removing rubber locking strip
- (7) Contact manufacturers or users of air suspension equipment for up to date information on vehicles

Instructor's Notes

e. Petroleum tank truck
  (1) Size and scope of emergency determines problems involved
  (2) Normally, safety feature installations permit safe and effective extinguishment and control of contents
  (3) Dome covers
    (a) Control liquid and vapor emission
  (4) Manifold
    (a) Extinguished with extinguishers or fog nozzles
    (b) Fire cannot extend through valves or piping
  (5) Overflow fires
    (a) Extinguished with fog nozzles
    (b) Cooling tank causes vents to close
  (6) Dangerous and serious situation created by:
    (a) Traffic accident
    (b) Overturned truck
    (c) Tank rupture
    (d) Place of incident
    (e) Life hazard involved
    (f) Building or vehicles involved
  (7) Responsibility for directing control rests with officer in charge
  (8) Recommend tactical problems be studied in regard to:
    (a) Water supply
    (b) Special extinguishing equipment
    (c) Mutual aid response
  (9) Factors influencing control and extinguishment
    (a) Water supply
    (b) Availability of special extinguishing equipment
    (c) Proper operating pressures on hose streams
    (d) Use of fog nozzles
    (e) Proper approach when extinguishing
    (f) Back up lines
    (g) Promiscuous use of solid streams
    (h) Control of gasoline run-off
    (i) Adequate sewer flushing operation
    (j) No smoking, open flames, or sparks
    (k) Roping off area for efficient operation of fire department
    (l) Cooperation of various local agencies for assistance and control

Instructor's Notes

(m) Use of combustible gas indicators to determine danger and spread of liquid and gas
(n) Awareness of exposure hazards
(o) Use of protective clothing by fire department personnel

13. Fires Involving High Tension Lines and Equipment

- a. Firemen should have some knowledge of danger involved
- b. Results of tests relative to safe operation reveal:
  - (1) A stream of water will carry current back to the nozzle
    - (a) Current may be sufficient to injure or kill a person
  - (2) Fires involving electrical charges can be safely controlled and extinguished, provided proper distances and precautions are observed
- c. The amount of current a fire fighter is exposed or subjected to will depend on:
  - (1) Amount of voltage involved
    - (a) The greater the voltage, the greater the ampere flow and current flow
  - (2) The distance from the nozzle to the charged wire or equipment
    - (a) The greater the distance, the greater the resistance, and therefore the smaller the amount of current
  - (3) The size of stream and nozzle
    - (a) The larger the stream and nozzle, the more current will be conducted
  - (4) The purity or conductivity of the water being used
    - (a) Mineral content determines the conductivity of the water
    - (b) Water from well, spring, river, pond, etc., more conductive than distilled water
  - (5) The type of stream - solid, broken or spray
    - (a) Separate drops of water do not make a continuous electrical path
  - (6) The pressure of the fire stream
    - (a) How pressure streams are most dangerous at short distances, and high pressure streams at longer distances
  - (7) The path of the current
    - (a) Wet hose on ground or in pool of water, grounded to earth
    - (b) Firemen standing on wet ground with elevated hose would act as ground to earth

Instructor's Notes

        - (c) Hose lines operated from fire escapes, coming in contact with high tension lines, fire escape acts as ground
      - (8) Protective clothing
        - (a) Firemen's rubber boots hould not be relied on completely for protection, due to cracks, leaks, or composition of material
    - d. Electrical oil fires
      - (1) Cut off current
      - (2) Extinguish same as other oil fires
        - (a) Spray or fog nozzles
      - (3) Portable "Class C" extinguisher
    - e. Transformer fires
      - (1) Contact utility company
      - (2) Apply water to control fire on pole or structure
    - f. Neon sign hazard
      - (1) Involves high voltage although current flow is low
        - (a) Sufficient to cause injury
      - (2) Shut off current
    - g. Consider every wire a hot wire
- 14. Lumber Yard Fires
    - a. Potential spread
    - b. Difficult to control and extinguish
    - c. Weather conditions contributing factor
    - d. To combat and extinguish
      - (1) Adequate water supply
      - (2) Attack from all sides if possible
      - (3) Concentrate efforts on confining
      - (4) Use heavy streams
      - (5) Protect area from flying brands and sparks
      - (6) Contact management on plan of operation, which should include the following:
        - (a) Means of alarm transmission
        - (b) Duties and responsibilities of watchmen and/or fire brigade
        - (c) Location plan of water supply, and other fire extinguishing media
        - (d) Location and storage facilities of flammable liquids
        - (e) Plan of yard facilities indicating entrances and driveways
        - (f) Arrangements for admittance if area is fenced in

Instructor's Notes

15. Refrigerator Fires
    - a. Domestic refrigerators
        - (1) Potential fire hazard relates mainly to motor and wiring
            - (a) Insulation failures
            - (b) Overloaded circuit
            - (c) Improper fusing
            - (d) Poor maintenance
        - (2) Danger from escaping gas
            - (a) Use self-contained gas masks
            - (b) Evacuate building
            - (c) Ventilate
            - (d) Disconnect appliance
    - b. Commercial refrigerators
        - (1) Fire fighting is difficult and dangerous
        - (2) Fire involves definite life hazard, because of refrigerants released
        - (3) Dangers when ammonia is involved
            - (a) Leaking pipes and tanks
            - (b) Tanks bursting under high pressure created by heat
            - (c) Explosion of ammonia gas
        - (4) Characteristics of ammonia gas
            - (a) Not easily ignited
            - (b) Explosive range 16% to 25%
            - (c) Presence of hydrogen gas created by decomposition of ammonia or oil used in the equipment
        - (5) Fire fighting
            - (a) Ventilate thoroughly
            - (b) Wet down tanks, piping and cylinder to keep cool
            - (c) Keep fire away from tanks if possible
            - (d) Wear self-contained gas masks
            - (e) Wear protective rubber clothing if available
            - (f) Avoid low areas, as gas is heavier than air
        - (6) Inspection practice
            - (a) Ascertain type of gas in use

16. Liquified Petroleum Gas Fires
    - a. L P gas is commonly known as bottled gas
    - b. Chief constituents are:
        - (1) Propane
        - (2) Butane
        - (3) Combination of both propane and butane
    - c. Produced from natural gas, or gases produced in refinery operations

Instructor's Notes

d. L P gas is hazardous
e. Firemen must exercise proper caution and judgment when dealing with L P gas
f. Gas is in liquid form when in container
g. When released from cylinder, liquid turns to gas
h. Gas or vapor can spread in area, or be windblown to another area
i. When proper air and gas mixture is attained it becomes potential fire hazard
j. Characteristics of L P gas
  (1) Explosive range
    (a) Butane - 1.6% to 6.5%
    (b) Propane - 2.2% to 9.5%
  (2) Ignition Temperature
    (a) Butane - 806° F.
    (b) Propane - 871° F.
  (3) Vapors are non-poisonous
  (4) Vapors are anaesthetic
  (5) Vapors will produce
    (a) Nausea, headache, asphyxiation
  (6) Two times heavier than air
  (7) Creates ventilation problem in low areas
  (8) Creates ignition problem in low areas
  (9) Odorless in normal state
  (10) Odorizing agent is added for detection by smell
  (11) Leaks can be detected by:
    (a) Odorant in gas
    (b) Signs of frost or mist at point of leak
  (12) L P gas is a refrigerant, any contact with body will result in freezing
k. Basic precautions in L P emergency
  (1) Approach from windward side
  (2) Evacuate persons in vapor cloud area
  (3) Eliminate sources of ignition
  (4) Evacuate persons in path of vapor cloud
  (5) Keep all civilian personnel at least 200 feet away from emergency area
l. L P gas installations should be provided with means of shutting off gas supply
m. Shut-off valves are usually provided at container
n. Leakage of L P gas not on fire
  (1) Close valve to stop flow
    (a) Use insulated gloves
  (2) If wrench is not available, crush or crimp tubing tightly together

Instructor's Notes

- (a) Use insulated gloves
- (b) Carry shut-off wrench on fire apparatus for availabilty

- (3) Disperse vapors with water spray
  - (a) Direct spray across vapor path
  - (b) Avoid handling of hose streams in vapor cloud if possible
  - (c) When handling hose streams in vapor cloud keep low, and behind spray stream
- (4) When enclosed areas are involved
  - (a) Use self-contained breathing apparatus
  - (b) Provide ventilation using air movers or smoke ejectors
  - (c) Purge area with carbon dioxide gas
- (5) Use combustible gas indicators to detect flammable atmospheres
- (6) When desirable to remove or isolate leaking tanks from potential source of ignition:
  - (a) Do not drag
  - (b) Set up overturned tanks carefully
  - (c) Avoid damage to valves and piping

o. Leakage of L P gas when on fire

- (1) Do not extinguish unless flow can be stopped
- (2) Keep container cool by applying water from all sides if possible
- (3) Do not use solid streams directly on tank to prevent overturning
- (4) Concentrate fog streams on container, piping, adjoining vessels, equipment and combustible surfaces exposed to flame or heat
- (5) Pressure release operation
  - (a) Spring loaded relief valve, will reset after temporary pressure increase
  - (b) Melting of fusible plug
- (6) Possibility of rupture even though equipped with safety relief valve
  - (a) Where flame impinges above liquid level, the metal weakens and the tank may rupture
- (7) Bulk storage or tank vehicle
  - (a) Stop flow of gas if possible
  - (b) Consult with plant personnel on shutting off the fuel supply when bulk storage is involved
  - (c) When fire involves valve operation, firemen wearing protective clothing should attempt to shut off and be protected with spray streams

Instructor's Notes

- (d) Carry out operation with caution and awareness of flashbacks
- (e) Heavy stream appliances with large capacity spray nozzles desirable, where large quantities of water are necessary to control

p. Controlled burning of L P Gas
  - (1) Where valves cannot be shut off
  - (2) When exposure hazard is not involved
  - (3) Shell and piping must be kept cool
  - (4) Allow fire to consume product without danger of tank rupture

q. Chemical extinguishers
  - (1) Dry chemical recommended
  - (2) Apply at base of fire

r. Danger signs indicating mounting pressure within tank
  - (1) Bubble or blister on outside shell
  - (2) Increase in volume of fire
  - (3) Increase in noise level of burning
  - (4) Withdraw firemen to safe location

s. Do not shoot holes in L P gas tanks

t. General information when large quantities on fire
  - (1) No specific method or material will extinguish
  - (2) Difficult to dilute air
  - (3) Impossible to blanket
  - (4) Keep tank and exposed equipment cool
  - (5) Prevent spread of fire

u. Exposure hazard control from adjacent fire
  - (1) Apply sufficient quantities of water to cool shell and piping to prevent overheating
  - (2) If relief valve functions, it should be allowed to burn or should be ignited
  - (3) Water should be applied to permit relief valve to close
  - (4) Remove portable cylinders to safe location

17. Aircraft Fires

a. Serious fire and life hazard involved

b. Complicates conventional extinguishment
  - (1) Type and large quantities of fuel involved
  - (2) Use of combustible metals in construction

c. Aircraft crash usually produces a fire

d. If possible, prevent start and spread of fire

e. Start rescue work immediately

f. Occupant survival time tests
  - (1) 50 to 300 seconds in crash fire

Instructor's Notes

    (2) 30 seconds when fire is unimpeded in cabin
- g. Develop techniques and special knowledge
    - (1) Air lines
    - (2) Military
    - (3) Crash fire fighting courses
- h. Concentrate on use of own equipment instead of special air field equipment
- i. Extinguishing media
    - (1) No single agent totally efficient
    - (2) Each has particular use and limitation
    - (3) Method of application will effect efficiency
- j. Water spray or fog
    - (1) Effective as extinguishing and cooling agent
    - (2) Provides cover protection for rescue
    - (3) Use governed by amount available
    - (4) Mutual aid arrangements recommended for auxiliary water supplies
- k. Foam
    - (1) Must be applied at high rate of volume
    - (2) Potential heat or water dilution will break down bubble structure
    - (3) Foam blanket must be maintained to be effective
- l. Protective clothing
    - (1) Normal "turn-out" or "bunker"
    - (2) Special materials
    - (3) Direct inquiry on subject to - N.F.P.A. and N.B.F.U.
- m. Recommendation for fire fighters protective clothing, contained in Suggestion for Aircraft Rescue and Fire Fighting Service for Airports and Heliports, N.F.P.A. pamphlet #403, May 1960
    - (1) Bunker suit with heat insulating interliners for coat and trousers to afford full arm, body and leg protection, outer garment to be water repellent and flame resistant
    - (2) Protective gloves of chrome leather with heat insulating interliner and gauntlet wrist protection
    - (3) Standard firemen boots with wool lining
    - (4) Fireman helmet with plastic full vision face shield and front and neck protective aprons

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 18 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 18, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #19

VENTILATION

OBJECTIVES:

1. To impress upon the learner the definition of and the advantages derived from efficient ventilation practices.
2. To study the purpose of and the correct methods to be used in ventilating buildings involved in fire
3. To become aware of the hazards involved in neglecting to follow certain procedures in ventilation

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad

REFERENCE:

Fire Service Training (text), Chapter 19, pp. 286-292.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Firemen must be aware that providing enclosed fires with proper and adequate ventilation is a very important factor in the control and extinguishment of such fires. Lack of knowledge or failing to apply ventilation practices properly may result in unnecessary punishment to the firemen and unnecessary loss. Therefore, EACH member of the fire department should keep ventilation constantly in their minds, and have a thorough knowledge of the principles and practices of ventilation

STEP II - PRESENTING THE LESSON:

A. DEFINITION OF VENTILATION

DEFINE - "Ventilation, as used in the fire fighting operations, means opening up a building or structure in which a fire is burning"

1. Results Achieved by Proper Ventilation
   - a. Relieves the structure of accumulated heat, smoke, and gases, making entry possible
   - b. Draws heat, smoke, and gases up a selected channel, preventing the spread of fire
   - c. Safely removes accumulated heat, smoke, and gases preventing explosion or back-draft

Instructor's Notes

2. What is Smoke
    a. DEFINITION - "Smoke is a mixture of gases and fine particles of carbon resulting from incomplete combustion due to the lack of oxygen"
    b. Dense smoke usually indicates little fire
    c. Free burning results in a small amount of smoke
3. What is Back Draft
    a. DEFINITION - "Back draft is the explosion caused by the admission of air, bearing oxygen to a fire which has not been burning freely"
    b. EXPLAIN characteristics of back draft
        (1) Gray-yellowish smoke
        (2) Pulsation of heat and smoke
    c. Lie down on stomach for best protection

B. ADVANTAGES OF VENTILATION
1. Prevents back draft
2. Permits promptly locating the seat of the fire
    a. Fire can be extinguished quicker
    b. Company can return to service quicker
    c. Removes the unpleasantness of the firemen's job when encountering smoke and dangerous gases
3. Permits promptly searching for victims
4. Reduces unnecessary smoke damage
5. Permits prompt salvage operations
6. Reduces the punishment of firemen
    a. Sickness
    b. Asphyxiation
    c. Injuries by falls, etc.

C. DISADVANTAGES OF VENTILATION
1. Public criticism
    a. Eliminate by education of public
2. Discuss disadvantages and means of eliminating same

D. HOW TO VENTILATE
1. Flat Roof
    a. Check roof for safeness
    b. Note wind direction
    c. Skylights or scuttle holes
    d. Chop hole
    e. Check for false ceiling below
    f. Do a neat job
2. Pitch Roof
    a. Check roof for safeness

b. Work from roof ladder, using safety measures
c. Use dormer windows or louvers if practical
d. Cut hole at highest point of roof, but slightly below the ridge row

3. Using Windows
    a. Do not open windows on all sides of building
    b. Note direction of the wind
    c. Open windows on lee side first, lower top window
    d. Next, open window on windward side, raise bottom window
    e. Open windows on top floors first
    f. Break out only if necessary
4. Using Basement Windows
    a. Types of basement windows
        (1) Hinged at top
        (2) Hinged at bottom
        (3) Hinged at side
    b. Some can be pried open
    c. Some - the center glass must be broken to get to lock
    d. Use smoke ejectors on lee side to pull smoke out

E. VENTILATION HAZARDS, CONSEQUENCES AND WARNINGS

1. Hazards
    a. If opened below fire
    b. If opened too soon
    c. If opened at wrong place
    d. Insufficient or delayed too long
    e. Life hazard to firemen
    f. May involve exposed buildings in fire
2. Consequences
    a. Danger of back draft
    b. Ventilation ineffective
    c. Poor preparation for attack on fire
    d. Increased loss
    e. Entire building involved or spread of fire to other buildings
3. Warnings
    a. Do not ventilate until lines are laid and charged, and men are ready to attack the fire
    b. Exposed property must be protected

F. SUGGESTIONS FOR VENTILATION

In each of the following items 1 thru 3, SKETCH the various figures referred to in the Fire Service Training (text) on the chalkboard and EXPLAIN.

Instructor's Notes

1. Vertical Ventilation
   a. Travel of gas
      Fig. 2, p. 289
      Figs. 3 & 4, p. 290
   b. Travel of gas in building with two shafts
      Fig. 5, p. 290
      Fig. 6, p. 291
2. Cross Ventilation
   Fig. 7, p. 291
3. Effect of opening a roof above a vertical shaft
   Figs. 8 & 9, p. 291

G. SUMMARY
1. Have a good mental picture of the building construction
   a. By preplanning
   b. By inspections
   c. By systematic survey
2. Know how heated gases, drafts, etc., travel
3. Know the contents of the building
   a. Fast burning
   b. Slow burning
   c. Produce toxic gases
   d. Explosives
4. Know the exposures
   a. Types of wall constructions
   b. Types of roof construction
   c. Wall openings
5. Firemen must be trained to use tools properly so they can do a neat job
6. Ventilate directly above fire if possible
7. Do not draw fire and smoke into the unaffected parts of the building
8. Ventilation should be given consideration in making the size-up
9. Do not ventilate until lines have been laid and charged
10. Good judgment must be used
11. Officer in charge should give orders to ventilate

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 19 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 19, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #20

SALVAGE

OBJECTIVES:

1. To convey to the learner the meaning and importance of salvage
2. To study the various tools and equipment used in salvage operation and their proper care
3. To learn the proper methods to follow to do efficient salvage work

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. List of salvage equipment carried by the department
3. 2 salvage covers
4. 2 Pike poles
5. Ladder for ladder chute
6. Sprinkler heads
7. Sprinkler stoppers or tongs

REFERENCE:

Fire Service Training (text), Chapter 20, pp. 293-307.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Salvage means saving of property. It should be given serious consideration by every fireman from the time of size-up until the fire is extinguished and the buildings and contents have been given proper care. Efficient workmanship in forcible entry, ventilation, and every job in the fire service is as much of salvage operations as the spreading of covers. A large percentage of the fire loss is the water and smoke loss. By using systematic and scientific manner of extinguishing the fire the firemen can reduce these losses. Good salvage operations is a fine way to secure the good will of the people we serve, and gives personal satisfaction of a job well done.

Inspection before the fire will aid in salvage operations and give the department knowledge of value of stocks, which stocks are easily damaged and the location of important records, location of floor drains, location of stairs and elevator shafts.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. SALVAGE EQUIPMENT

1. May vary and depends upon local conditions
2. Each department should select the equipment they need
3. Some of the items may be found at the scene of the fire or neighboring buildings
4. Suggested list of tools and supplies:

SHOW and DISCUSS use of items as required.

- Sprinkler heads
- Sprinkler stoppers (or tongs)
- Crow bars
- Pike poles
- Claw hammer
- Nails (roofing and assorted)
- Scoop shovel
- Brooms (regular and wire)
- Gas and water keys
- Sponges and chamois
- Roll roofing paper
- Augers
- Sawdust
- Portable lights
- Skids
- Saws
- Pipe wrenches
- Hasps and locks
- Buckets and tubs
- Forcible entry tools
- Salvage covers
- Debris bag
- Bath towels
- Squeegees and mops
- Screw drivers
- Runners
- Mattress hooks
- Deodorant
- Wood lath

B. SALVAGE WORK DURING THE FIRE

1. Throw runner to protect the floor
2. Place salvage covers to protect property from water and falling debris
3. Use covers to bag floors
4. Divert and remove water from building
5. Protect the contents of building from vandalism
6. Debris bag

   REFER learners to Figs. 2 & 3, pp. 294 & 295, Fire Service Training (text).

   a. Made from water proof material
   b. Size is 6 ft. by 6 ft.
   c. Has 16 grommets and 26 ft. of 3/8" rope
   d. EXPLAIN how and when it should be used
7. Removing Mattress from Building
   a. Knock down fire
   b. Roll tight and secure mattress hooks
   c. Wrap in salvage cover
      (1) Keep dirt and fire from non-involved areas
   d. Carry out of building and overhaul outside

C. SALVAGE COVERS

1. EXPLAIN - That salvage covers are water-proof tarpaulins of conventional size for handling, used for covering

materials, equipment and furnishings

2. Sizes vary - 9' x 12' to 14' x 18'
3. Types of covers:
    a. Rubber covered (both sides)
    b. Rubber covered (one side)
    c. Duck or canvas-treated with linseed oil compound
    d. Closely woven canvas-specially treated
    e. Plastic material
4. Advantages and Disadvantages of Different Types of Covers:
    a. Rubber will hold more water
    b. Rubber is heavier
        (1) May slip from shelves
        (2) Hard to roll for baging
    c. Some canvas covers
        (1) Become soft and sticky when exposed to heat
        (2) Will leak under pressure
        (3) Become brittle and crack
        (4) Water proofing solution is worn away by extensive use
        (5) Are more difficult to patch
        (6) However, treated canvas or plastic is preferred because of lightness and ease of handling
5. Folding and Carrying Covers:

    SHOW and have group PRACTICE the various folds and carries. Recommend learners adopt a suitable fold for their own departments salvage operations.

    a. One man throw fold
    b. Two man throw fold
    c. The accordian fold
    d. The salvage cover roll and double roll
6. Throwing and Spreading Salvage Covers

    SHOW and have group PRACTICE throwing, spreading, and removing covers.

    a. One man throw
    b. Two man throw
7. Removing Salvage Covers
    a. Use extreme care to prevent damaging objects covered
    b. Start with corners and fold or roll cover off
    c. Do not drag off
    d. Carry from building - do not throw

D. COVER WORK AT FIRES

1. Bag floors
2. Where bags will not hold water, cover all floors below
3. If covers are limited, cover most valuable items
4. Spread covers in exposed areas first

Instructor's Notes

5. Elevate rolled edges of bags if necessary
6. Stacking stock or furnishings
    a. Stress the importance of stacking properly
    b. Use care to prevent breakage or damage
    c. Stack where least exposed to water
7. Residential Fires
    a. Covering bedroom
        REFER learners to Fig. 13, p. 299, Fire Service Training (text).
        (1) Roll rug (bag if nailed down)
        (2) Move bed near and parallel to wall
            (a) Remove it from under light fixture
            (b) Floors are stronger near the walls
            (c) Don't place too close to wall which will hamper inspection for fire
        (3) Chest of drawers
            (a) Put all articles on chest in top drawer
            (b) Place chest at head of bed
        (4) Vanity
            (a) Remove mirror and place on bed
            (b) Place articles on top of vanity in top drawer
            (c) Move to foot of bed
        (5) Pictures and lamps
            (a) Place on bed
            (b) Place lamp shades up right
        (6) Clothing
            (a) Remove all clothing from closets
            (b) Place them carefully on top of pictures and lamps
        (7) Chairs
            (a) Place carefully on top of clothes on bed
        (8) Place rolled rug over stack
        (9) Cover stack and exposed floor
    b. Covering the living room
        (1) Roll rug if not fastened down
        (2) Move davenport and over stuffed chairs together forming a box
            REFER learners to Fig. 14, p. 300, Fire Service Training (text).
        (3) Lamps
            (a) Remove shades and place in box upright
            (b) Lamp bases are placed on stack last
        (4) T.V. set
            (a) Place on davenport, face down
            (b) Consoles may be covered separately
        (5) Coffee tables, stands and stools
            (a) Place in box formed by chairs and davenport

Instructor's Notes

(6) Book cases
(a) If movable place behind of davenport
(b) If not movable:
Use separate cover
Roll at top or tuck behind top shelf
If shelves go to the ceiling,
1. Remove articles from top shelf
2. Roll top of cover into top shelf
(7) Secretary and desk - place at end of davenport
(8) Radio and record player
(a) Place table models in box
(b) Consoles may be covered separately
(9) Curtains, drapes, blinds, and pictures
(a) Remove from windows
(b) Fold neatly and place in formed box
(c) Place pictures and blinds in formed box
(10) Piano and stool - cover separately
(11) Cover exposed floor
c. Covering the dining room
(1) Roll rug
(2) Table and chairs
(a) Move table to one side of room
(b) Place chairs upside down on table
Seat pads should rest on finished surface
Do not scratch finish
(c) Place arm chairs under table, upright
(3) Pictures and drapes placed on top of table
(a) Use rug for ridge pole and cover
(4) Side board and china closet
(a) Place back to back
(b) Use care, not to break dishes
(5) Cover exposed floor
d. Covering the bathroom and kitchen
(1) They need less attention (water proof)
(2) Electrical appliances must be covered and protected
e. Covering the basement
(1) Things to consider
(a) Furniture in play room
(b) Tools in work shop
(c) Deep freezer - should the power be off for a time, advise occupants to remove food to proper storage
f. Where jewelry, pocket books, etc., are present they should be placed in dresser drawer or turned over to a reliable person in presence of a witness

Instructor's Notes

8. Industrial
   a. Cover entire machines separately, being careful not to tear or damage covers
   b. Cover file cabinets
      (1) Records and years of research may be saved
      (2) Many records and prints cannot be replaced
      (3) Stack material on skids before covering
9. Mercantile
   a. Shelves present difficult problem
      (1) Built to ceiling using wall for backing
      (2) Shelves may be 2 inches from wall
      (3) Use (S) hooks made from 3/16 C.R. Steel
         (a) Sharpen both ends
         (b) Can be driven in wood and plaster
         (c) Hooked in grommets
      (4) Pike poles can be used to form lean-to
   b. Show cases
      (1) Top of case needs support
         (a) Use chair or other object across frame
         (b) To prevent breakage from falling plaster
   c. Breakable merchandise which is exposed
      (1) Place covers carefully
         (a) Do not throw
   d. Materials in storerooms or basement
      (1) Place on skids if possible
      (2) Cover for protection
      (3) Control drainage

E. CARE OF SALVAGE COVERS

1. Remove covers carefully
2. Unnecessary walking on covers should not be allowed
3. Use nails through grommets only
4. Refold each month, if not used
5. When used to cover roof, remove all nails and jagged points to prevent tears
6. Covers should be washed and dried as soon as possible after use
7. Keep clean, dry and in good repair
8. Torn covers should be taken out-of-service for repair or replacement

F. REMOVING WATER FROM BUILDINGS

***EXPLAIN** the 7 general means of removing large quantities of water from upper floors.*

1. Elevator shafts
2. Stairway chute

   ***DEMONSTRATE** or **REFER** learners to Fig. 18, p. 302, Fire Service Training (text).*

Instructor's Notes

3. Holes cut from floor to floor
4. Chutes to the outside

   ***DEMONSTRATE** or **REFER** learners to Figs. 19, 20 & 21, p. 303, Fire Service Training (text).*
5. Catchall

   ***DEMONSTRATE** or **REFER** learners to Fig. 22, p. 303, Fire Service Training (text).*
6. Scuppers
7. Breaching walls
8. Basement drainage
   - a. Ascertain that floor drains are unobstructed
   - b. Check basements in adjoining buildings where heavy streams are being used
   - c. If possible, remove stock from floor to avoid water damage
   - d. Where floor drains prove inadequate, soil pipes leading from roof drains and upper floor plumbing can be broken off at floor level to aid in draining basement
   - e. Toilet bowls pried from floor allow draining facilities
   - f. When water rises where it is about to come in contact with motors, refrigerating systems, etc. shut power off by pulling main electrical switch
9. Salvage in Sprinklered Buildings
   - a. Fire officers should have a knowledge of sprinkler systems
   - b. Tongs or stoppers are used to stop water flow
     - (1) When valve room is locked
     - (2) Control valve can not be located
   - c. Do not shut off until fire is under control
   - d. Have sprinklers put back in service as soon as possible
     - (1) By maintenance engineer
     - (2) Heads of various fusing temperatures should be available
     - (3) Fire may rekindle
     - (4) Another fire may occur
     - (5) Leave man at scene if in doubt

G. SALVAGE OPERATIONS AFTER EXTINGUISHMENT

1. Remove water from floors and basement
2. Complete ventilation to remove smoke and heat
3. Dry machinery, furniture and stock
4. Remove articles of value from the debris
5. Clean and oil machines to prevent corrosion
6. Shut off and drain water systems in freezing weather

Instructor's Notes

7. Cover holes in roof and other openings
8. Place heating plant in operation
9. Protect contents from vandalism

H. SALVAGE OVERHAUL
1. Piles of debris
    a. Should not be wet down with hose - dip in bucket of water
    b. Put wet debris in bagged cover
    c. Do not throw partially burned stock or material from building
2. Use portable fans for ventilating and drying purposes

I. COLD WEATHER PRECAUTIONS
1. Close openings
2. Heating system should be placed in operation
3. If heating system can not be restored
    a. Drain tanks, boilers, and pipes
    b. Remove water from drain traps
    c. Salt can be used in toilets and traps

J. COVERING ROOFS AND WINDOWS
1. It is poor practice to salvage stock and furniture and have them later destroyed or damaged by inclement weather
2. Covering holes in peaked roofs
    a. Raise roof material on roof above the hole
    b. Insert the end of tar paper under it
    c. Bring it down over the hole
    d. Fasten with roofing nails
    e. Large holes
        (1) Cover from the bottom up
        (2) Lap each strip of tar paper over strip below
        (3) Nail lath or boards on edges
3. Skylights

    REFER learners to Fig. 23, p. 306, Fire Service Training (text).
    a. Cover with tar paper and nail down
    b. Use salvage cover - weigh down edges to prevent wind from blowing it off
4. Flat roofs

    REFER learners to Fig. 24, p. 306, Fire Service Training (text).
    a. Raise roof material around hole 4 to 6 inches
    b. Block up with board or brick before covering
        (1) To prevent water from flowing in hole
5. Windows
    a. Keeps weather and looters out

Instructor's Notes

b. Use salvage covers-nail through grommets
c. Use tar paper, lath and nails

K. SUGGESTIONS FOR DRILLS AND TRAINING

1. Efficient handling of covers requires team work. To gain this team work, practice and drills are necessary

***REFER** to and **DISCUSS** the suggestions covering the types of drills and instructions which will aid materially in solving salvage problems, as listed on p. 306, Fire Service Training (text).*

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 20 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW UP:

REVIEW Assignment Sheet No. 20, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #21

OVERHAUL AND PICK-UP

OBJECTIVES:

1. To learn the importance of overhauling and the proper methods to follow.
2. To point out the need for and the proper care of fire equipment after the fire is extinguished.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Sample of marked equipment and hose for company or department identification

REFERENCE:

Fire Service Training (text), Chapter 21, pp. 308-310.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Overhauling consists of two objectives, namely, making sure the fire is out and leaving the building in as servicable a condition as possible. This, in most situations, takes a great deal of time in carefully checking the involved building in order to be positive that the fire is completely extinguished and will not rekindle.

After the fire is extinguished, there is much to be done in picking up. This is important in keeping equipment in first-class condition, ready for the next fire.

STEP II - PRESENTING THE LESSON:

A. OVERHAUL
  1. Method of operation After Fire has been Extinguished
    a. Search for any sparks or fire that remain in the building or articles which have been subjected to the fire
      (1) First requisite is to make sure the building is safe to work in. Two factors to consider are:
        (a) The extent to which structural parts have been weakened by the fire
        (b) The additional weight added to the building and contents from water used to extinguish the fire

Instructor's Notes

(c) Knowledge gained by inspection before fire occurs will aid in determining absorbing qualities of contents

2. Careful check should be made to determine if fire has extended to other parts of the building by:
    a. Stairways, elevator shafts, dumb waiter shafts
    b. Through partitions
    c. Between ceilings and floors
    d. Through pipe recesses
    e. Roof and floor beams - resting on party walls
        (1) Remove burned ends
        (2) Flush out with water
        (3) Check far side for fire and water
3. Where indications warrants or doubt exists, open all hollow spaces
    a. Above
    b. Beneath
    c. Both sides
    d. These places could contain gas from defective pipes
4. Check door and window casing
    a. Remove to make sure fire has not extended to space behind
5. Check pipe openings
    a. Make large opening for inspection
    b. Fire may follow pipe a considerable distance
6. Check window weight ropes for smoldering embers
7. Check roof or cornice
    a. Open up cornice as the fire may have mushroomed against the under side of the roof and spread
    b. Avoid heavy jarring strokes when chopping
8. Common sense should always be used in overhauling to eliminate additional damage. Firemen should act as though they owned the property and it was not insured
9. Overhauling Material in Building
    a. Clear away a space at each end of room, where overhauled goods can be placed
    b. Start at the top and work down
    c. Overhaul one piece, layer or shelf at a time
    d. Do not cover any material that might contain fire
    e. Pile heavy objects near walls to avoid overloading floors
    f. Do not throw clothing or valuable articles out the windows
        (1) Handle all articles carefully
    g. Smoldering debris in buildings should not be wet down with hose streams

Instructor's Notes

(1) This will add to water damage

(2) Dip in pail of water

(3) Overhaul - after removal from building

h. Remove only non-salvageable debris such as plaster, etc.

i. Partially burned articles should be sorted from debris and put asside

(1) May be useful in preparing inventory loss

j. Drug stores, chemical warehouses, paint shops, etc. demand special attention

(1) Care must be taken not to break bottles or cans

(a) Cans damaged by fire could break when dropped

(b) Bottles and cans may contain material which could cause serious complications if broken

(c) Remove from shelf one at a time

(d) Handle leaking poison containers with care

(2) Gas masks should be worn at all times

(3) Wash hands and tools thoroughly

k. Remove and protect furniture when plaster and lath must be pulled down

10. Procedure to employ in doing a thorough job of overhauling

a. Completely inspect the exposed and involved areas

b. Be diligent in looking for fire in concealed spaces

c. Check all avenues through which the fire may have extended

d. Remove all broken or damaged glass from windows, doors, etc.

e. Remove broken glass from sidewalk and street

f. Preserve and safeguard any evidence of incendiarism

g. Check building and contents with owner to determine:

(1) Prior entry to building

(2) Prior theft

h. Cut off current at main switch if electric wiring has been exposed to fire or damaged

i. Turn off gas system at street valve if damaged

j. Unsafe conditions - eliminate or post warning signs or lights

k. Put building and contents in the best possible condition

l. Advise owner and occupant as to the hazards existing and recommend necessary precautions to be taken

m. Sprinkler system should be put back in service

n. Use common sense in handling materials

Instructor's Notes

o. Obtain the necessary data for fire reports
p. Release the building and contents to owner, authorized agent, or proper police officials
q. Whenever doubt exists about complete extinguishment, always leave a reliable person with a suitable extinguishing agent

Additional information pertinent to this subject may be found in the Salvage chapter, Fire Service Training (text).

B. PICK-UP

1. EXPLAIN that pick-up consists of picking up equipment and restoring apparatus and equipment to normal condition
2. Do all that can be reasonably accomplished on the fire grounds to prepare for the next fire
3. Radiation material fires
   - a. Do not remove tools, equipment or clothing from contaminated areas
4. Be positive all equipment is in place and free from dirt and grime
5. When tools are carried into building and are no longer needed, place them near exit where they can be easily found
6. Do not drive over hose when picking up lines
7. Mutual Aid or Multiple Alarms
   - a. Pick up only the equipment that belongs on your apparatus
   - b. Leave all other equipment at the fire grounds
   - c. If time permits assist other firemen locate their respective hose, tools, and equipment
   - d. Recommend that all hose, tools and equipment be marked
     - (1) Saves time and errors in Pick-Up
     - (2) Assists each department or company in finding its respective equipment

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 21 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 21, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #22

CARE OF APPARATUS, DRIVING SUGGESTIONS, THE RUN

OBJECTIVES:

1. To learn the essential items to be considered in the general care and maintenance of fire apparatus
2. To acquaint the learner with driving suggestions which will be an invaluable aid in helping him to become an efficient, considerate and safe driver.
3. To acquaint the learner with the characteristics of apparatus warning devices.
4. To acquaint the learner with stopping and reaction limitations so as to enable him to arrive safely at the fire scene.
5. To acquaint the learner with state laws relating to emergency vehicles.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. American Automobile Association booklet, "How to Drive"
3. Films available from Department of Highway Safety film library, 240 S. Parsons Ave., Columbus, Ohio
4. Consult A.A.A. for available film

REFERENCE:

Fire Service Training (text), Chapter 22, pp. 311-315.

Instructor's Notes STEP I - INTRODUCING THE LESSON:

Apparatus represents one of the largest investment of any fire department. Such an investment requires that excellent care be given by those who are charged with the responsibility of proper operation and maintenance. This is necessary so that emergency equipment will last for a reasonable length of time. Fire apparatus is emergency equipment and unless properly carred for, may not function properly when the occasion arises. To safeguard against malfunction that may be due to neglect, firemen must know the fundamentals of proper operation, maintenance and use of fire apparatus.

Drivers must be acquainted with the safe driving practices and laws relating to the handling of emergency apparatus. They are responsible for the safe operation of an emergency vehicle and should understand the limitations involving the use of warning devices.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. CARE OF APPARATUS
  1. Keeping apparatus clean, general methods to follow:
    a. New apparatus should be washed frequently with pure water
      (1) Will harden finish
      (2) Will prevent finish from spotting
    b. Never wash hood while hot
      (1) Will effect gloss of finish
      (2) Will cause finish to become dull
    c. Do not turn hose spray on the hood
      (1) Water may get under the hood
      (2) May affect the ignition system
    d. Apparatus should be thoroughly cleaned after each run:
      (1) Mud should never be permitted to dry on apparatus
      (2) Use plenty of water to soak off mud. Avoid using hot water
      (3) Grit, mud, dirt are sources of excessive wear
      (4) If using hose, avoid excessive pressure as it will drive dirt and grit into the finish
      (5) Dry with a clean chamois, rinsing frequently in clean water
      (6) Heavy coat of dust should be removed by washing
      (7) Remove light coat of dust using soft woolen or chemically treated cloth
    e. Keep truck far enough away from fire to avoid blistering finish
    f. Polish nickel and brass parts when needed
      (1) Use a good grade of polish
      (2) Avoid getting polish on painted finish of truck
    g. Stainless steel and chrome trim should be wiped with a soft clean cloth
  2. Routine Maintenance and Inspection of Apparatus
    a. The care and maintenance of any apparatus and its related equipment:
      (1) The direct responsibility and obligation of the men assigned this duty
      (2) The officer in charge should direct the work and inspect the results
      (3) This procedure does not mean the men are unreliable
        (a) Places different levels of responsibility where they belong

Instructor's Notes

(b) Officer's duty to see that his equipment is ready to respond at all times

b. Routine inspection of apparatus

(1) Importance of inspections - assures good performance over a long period of time

(2) Inspections must be thorough and systematic

(3) A complete record of inspection details should be kept

(4) Instructions in manufacturer's booklet should be carefully studied and followed

(5) Defects should be corrected immediately

(6) Daily inspections

- (a) Brakes and their related parts
- (b) Gasoline and oil levels - refill if necessary and look for leaks. (Allow for expansion of gasoline)
- (c) Tires should be checked for foreign bodies, cuts and air pressure
- (d) All gauges and instruments
- (e) Battery
- (f) Radiator - water level of cooling system
- (g) Seat safety belts - if so equipped
- (h) Lights - head, tail, stop, directional, dash, dome, compartment and warning
- (i) Steering mechanism
- (j) Mirrors - rear and side(s)
- (k) Siren - for proper operation
- (l) Windshield wipers

(7) Weekly inspections

- (a) Check fan and generator belts
- (b) Pump shift levers and safety locks
- (c) Clutch
- (d) Starter - both switches if so equipped
- (e) Windshield wipers and blades
- (f) Clean and tighten battery connections, inspect cables
- (g) Check gas, oil, and water for leaks (engine hot and running)
- (h) Check all equipment, brackets and holders
- (i) Check all pump controls
- (j) Check pump governor or relief valve
- (k) Check all discharge and suction port caps and gaskets
- (l) Check exhaust system
- (m) Check all nozzles
- (n) Check auxiliary generator and flood lights

Instructor's Notes

- (o) Check all masks and breathing equipment
- (p) Check all other miscellaneous appliances or equipment (axes, pike poles, extinguishers, ladders, etc.)
- (q) Check aerial ladder operation
- (r) General performance and appearance of apparatus

(8) Monthly Automotive Inspection Report form

***REFER** to and **DISCUSS** Figs. 1 & 2, pp. 312 & 313, Fire Service Training (text).*

B. DRIVING SUGGESTIONS

1. **Accident records show that the driver is more often responsible for traffic troubles than the car, weather and road conditions**
2. **Driver quality is the critical ingredient in the traffic recipe**
   - a. **Neither age, sex or skill stamps a driver with high quality**
   - b. **The stamp of quality comes with a combination of good physical condition, sound driving knowledge and skill**
3. **Many of us who have been driving for years, had to rely on instinct and experience to enable us to maneuver in and out of traffic**
   - a. **We had no code of ethics for safe driving**
   - b. **Not so today, driver training is an important part of the school curriculum**
   - c. **Textbooks are available explaining the ground rules, laws, etc.**
   - d. **There are also machines to evaluate your physical and mental fitness, such as:**
     - (1) **Field of vision**
     - (2) **Judgment of distance**
     - (3) **Steadiness**
     - (4) **Reaction timing**
     - (5) **Whether you are color blind**
   - e. **For those who have not had the benefit of todays driver training, many good booklets are available at your automobile club**
4. **Whenever you participate in any activity, you should know the ground rules and abide by them**
   - a. **Members of the fire department have two sets of rules to follow:**
     - (1) **Applies to you as a driver of an automobile**

Instructor's Notes

    - (a) Must have drivers license
    - (b) To be acquainted with the laws governing the operation of a motor vehicle
    - (c) Abide by the laws
    - (d) Thorough knowledge of safe driving practices
  - (2) Applies to you as a driver of an emergency vehicle
    - (a) Must have drivers license
    - (b) To be acquainted with the laws governing the operation of an emergency vehicle
    - (c) Abide by the laws and remember you are not driving a pleasure car

5. By nature we are creatures of habit
   - a. After driving our own car for a few days, we may suddenly be called upon to drive a piece of fire apparatus
   - b. This would require a rapid readjustment in our driving skill relative to judge and control location, manual gear shifts, etc.
6. A week or two may pass without a run for your particular piece of apparatus
   - a. That is why it is so important to be thoroughly acquainted with your equipment
   - b. Understand its reaction and limitations under different conditions
7. To be a good driver today, requires practice, review and concentration
   - a. Study the location of light, ignition and starter switches, emergency brake releases, gear shifting mechanism and other controls
   - b. Review them until you are able to manipulate them automatically
8. Keep in mind that fire apparatus is a heavy piece of equipment and most of them have hydraulic brakes
   - a. Very few have power brakes
   - b. More foot pressure and a greater distance is required to bring it to a stop
9. Practice driving until you understand the reaction and limitations of your apparatus
   - a. Keep in mind that you are not driving a pleasure car
10. Some Do's and Don'ts that Make for Safety in Driving if put into practice, will help keep the apparatus in the best operating condition
    - a. The motor should not be run at excessive speed
    - b. Release the emergency brake or electric hand brake before engaging the clutch

Instructor's Notes

c. When shifting gears, be sure that the clutch is entirely disengaged

d. The gear shift lever should be moved cautiously into proper position and not jammed into place

e. Engage the clutch gradually

f. Depress or release the accelerator gradually

g. Start apparatus in low gear when at a standstill
   (1) Do not "jump" the apparatus in starting
   (2) Remember that the apparatus is a tremendous dead load and sudden starting will increase the possibility of mechanical failure of some of the parts

h. As a general practice, it is not advisable to shift into second gear until the apparatus is clear of the station and the driver has a clear view of street traffic conditions

i. Do not drive at an excessive speed
   (1) Remember that the first necessity is to get to the fire
   (2) Speed of response is secondary

j. Proceed at intersections with caution
   (1) Remember that the "other fellow" may prevent the apparatus from reaching the fire

k. Remember that the safety of fellow firemen has been entrusted to the driver

l. Become acquainted with the braking reaction of the apparatus
   (1) Modern brakes, if applied to rapidly, may be as disastrous in effect as slow application

m. Do not disengage clutch when braking until the last few feet of forward motion
   (1) Under ordinary conditions, and particularly when streets are wet or icy

n. Driver should anticipate braking failure after apparatus has been driven through deep water

o. Never attempt to reverse the direction of the apparatus until brought to a full stop

p. Drivers must anticipate the need of shifting-down on hills and turns
   (1) In order to maintain a maximum safe speed
   (2) This will also help prevent overworking of the machine

q. Drivers of fire apparatus equipped with automatic transmissions should adhere to manufacturer's instructions

Instructor's Notes

r. Winter driving on snow and ice
  (1) Glare ice is most dangerous at 20° to 30° F.
  (2) At 32° F. at 20 M.P.H., braking distance on ice is about 250', 140' farther than at 0° F.
    (a) Regardless of temperature variation, reinforced chains reduce braking distances to about 77' at 20 M.P.H.
  (3) This freezing-thawing point produces the most slippery road surface of all when snow and ice conditions prevail
  (4) Keeping road traction is the important thing
    (a) Keep the vehicle pulling steady - moderate power is needed, not speed
    (b) Don't make sudden changes in speed, gear ratio or direction
  (5) To slow down or stop, lightly pump the brake pedal in rapid succession, on and off two or three times per second
    (a) This lock, roll, lock, roll action permits the front wheels to steer as they roll
    (b) The intervals of steering will keep the vehicle from skidding off a crowned road
  (6) Reinforced chains are the best insurance when snow and ice conditions prevail

C. THE RUN
1. Drivers of emergency vehicles are responsible for their safe operation
2. Necessary for drivers to understand the limitations of the use of red warning lights and sirens
  a. Red lights
    (1) The red flasher light is a better warning signal to on-coming traffic than to traffic being approached from the rear
    (2) When no visual obstruction exists, the red flasher light is often more effective than the siren
      (a) It attracts the attention of the oncoming drivers from a greater distance
  b. Siren
    (1) Excellent warning device
    (2) Has limitations
      (a) Three times more projection straight ahead than to the side or rear
      (b) A person with normal hearing, seated in a car approximately 1,000 feet straight

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ahead with the drivers window open, can hear the siren
- (c) Variation of noises and sound obstacles (radios, trucks, buses, etc.) will alter the distance
- (d) When the listener is at a right angle to the path of the emergency vehicle, the sound is reduced approximately two-thirds

(3) Techniques and cautions in use
- (a) Unless automatically controlled, the siren should be brought alternately from low pitch to high pitch
- (b) Varying pitch will attract more attention
- (c) Many people are deaf to a certain tone
- (d) Siren and warning lights do not guarantee safe passage at dangerous intersections
- (e) Driver is required by law to excerise due regard for the safety of all persons when proceeding through a red traffic light or stop sign
- (f) Use of the siren should be restricted to genuine emergencies only
- (g) When approaching a vehicle from the rear, siren should be actuated well in advance to avoid startling the motorist

3. Other Safety Hints
   - a. Emergency vehicle drivers should excerise caution when passing vehicles
     - (1) Especially when necessary to cross center lines
   - b. No emergency vehicle should pass another emergency vehicle until an all clear signal is received
   - c. Safe following distance is 500 feet
   - d. Safe following distance when returning to quarters in feet is twice the speedometer reading plus 30%
   - e. Special caution is required when apparatus is responding from two or more locations
4. Reaction distance in relation to speed and stopping

   DEFINE the following:
   - a. "Speed - miles per hour vehicle travels"
   - b. "Reaction distance - distance vehicle will travel while driver is transferring his foot from the accelerator to the brake pedal"
   - c. "Braking distance - the distance a vehicle will travel after brakes have been applied"
   - d. "Stopping distance - sum of reaction distance plus braking distance"

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e. Distances will vary due to:
  (1) Mental and physical alertness of the driver
  (2) Speed, type and condition of the vehicle
  (3) Condition of brakes, tire sizes and weight of vehicle
  (4) Condition and type of road surface

f. EXAMPLES of stopping distances
  (1) An average car traveling at 40 M.P.H., travels 59 feet per second - reaction distance is 44 feet - braking distance is 81 feet
    (a) Total stopping distance is 125 feet for an average car
  (2) A pumper, traveling at 40 M.P.H. equipped with 4 wheel brakes, travels 186 feet (stopping distance)
  (3) At 60 M.P.H., the stopping distance for the average car under normal conditions is 272 feet
  (4) For a fire pumper, 638 feet stopping distance is required at 60 M.P.H.

g. Other factors to consider when responding to an emergency
  (1) The number of traffic lights that will be encountered on the chosen route
  (2) Dangerous intersections that may be encountered, as well as railroad crossings
  (3) The number of turns to make on the route and any steep grades that may be encountered
  (4) The prevailing weather conditions at the time of the call and the congestion of traffic

h. Traffic light control
  (1) It is considered good policy to have control switches put on traffic lights and these connected to the alarm system
    (a) So that lights can be controlled on caution or red to assist the apparatus through a congested area
  (2) Some cities have traffic light controls mounted on the main pieces of apparatus
    (a) This enables them to control the lights as they are approached enroute to the call

5. Traffic laws applying to all other vehicles shall be observed when returning to quarters

D. THE FOLLOWING STATE LAWS GOVERNING THE OPERATION OF EMERGENCY VEHICLES ARE QUOTED FROM THE REVISED CODE:

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R.C. 4511.1 (6307-2) Definitions

(D) "Emergency Vehicle" means fire department, police and state highway patrol vehicles, vehicles of salvage corporations organized under sections 1709.01 to 1709.07, inclusive, of the Revised Code, emergency vehicles of municipal or county departments or public utility corporations when identified as such as required by law, the director of highways or local authorities, motor vehicles when commandeered by a police officer, ambulances, and motor vehicles when used by volunteer firemen responding to emergency calls in the fire department service when identified as required by the director.

Sec. 4511.03 (6307-4) Emergency vehicles to proceed cautiously past red or stop signal.

The driver of any emergency vehicle, when responding to an emergency call, upon approaching a red or stop signal or any stop sign shall slow down as necessary for safety to traffic, but may proceed cautiously past such red or stop sign or signal with due regard for the safety of all persons using the street or highway.

Sec. 4511.24 (6307-24) Emergency vehicles excepted from speed limitations.

The Prima-Facie speed limitations set forth in section 4511.21 of the Revised Code do not apply to emergency vehicles when they are responding to emergency calls, and when the drivers thereof sound audible signals by bell, siren, or exhaust whistle. This section does not relieve the driver of an emergency vehicle from the duty to drive with due regard for the safety of all persons using the street or highway.

Sec. 4511.45 (6307-44) Emergency vehicles have right of way.

Upon the approach of an emergency vehicle, equipped with at least one flashing red light visible under normal atmospheric conditions from a distance of 500 feet to the front of such vehicle and the driver is giving audible signal by siren, exhaust whistle or bell, the driver of every other vehicle shall yield the Right of Way. Immediately drive to a position parallel to and as close as possible to the edge or curb of the highway clear of any intersection, and stop and remain in such position until the emergency vehicle has passed, except when otherwise directed by a police officer. Upon the approach of an emergency vehicle, as stated in the first paragraph of this section, the operator of every streetcar or trackless trolley shall immediately stop such car clear of any intersection and

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keep it in such position until the emergency vehicle has passed, except when otherwise directed by a police officer. This section does not relieve the driver of an emergency vehicle from the duty to drive with due regard for the safety of all persons and property upon the highway.

Sec. 4511.72 (6307-70) Following an emergency vehicle prohibited.
The driver of any vehicle, other than an emergency vehicle on official business shall not follow any emergency vehicle traveling in response to an alarm closer than 500 feet, or drive into or park such vehicle within the block where fire apparatus has stopped in answer to a fire alarm, unless directed to do so by a police officer or a fireman.

Sec. 4511.73 (6307-71) Driving over unprotected fire hose.
No streetcar, trackless trolley, or vehicle shall without the consent of the fire department official in command, be driven over any unprotected hose of a fire department, when said hose is laid down on any street, private driveway, or streetcar track to be used at any fire or alarm of fire.

Sec. 4513.03 Lighted Lights Required.
Headlights are required to be turned on, one half hour after sunset until one half hour before sunrise and at all other times when there is not sufficient natural light to render discernible persons, vehicles and substantial objects on the highway at a distance 500 feet ahead. Parking lights are not acceptable.

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 22 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOWUP:

REVIEW Assignment Sheet No. 22, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #23

POST-MORTEM CONFERENCE

OBJECTIVES:

1. To learn the importance of post-mortem.
2. To learn the proper procedure to follow in conducting a post-mortem.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad

REFERENCE:

Fire Service Training (text), Chapter 23, pp. 316-317.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

"A post-mortem is an evaluation of what has taken place during the course of the emergency or emergencies." It is conducted to make a careful analysis of every phase of operation, to point out errors and mistakes. It will point out what can be done in the future to further expedite and obtain a more efficient operation.

STEP II - PRESENTING THE LESSON:

A. EXPLAIN that a post-mortem should be held as soon as possible after the run, and should cover every phase of the operation

B. HOW TO CONDUCT A POST-MORTEM
  1. When Conducted
    a. As soon as possible
    b. At weekly or monthly meetings
    c. Change of shifts
  2. Who Conducts the Post-Mortem
    a. Officer in charge of the run
    b. A designated officer
  3. Who Takes Part
    a. ALL personnel involved in the run
    b. Results should be passed on to other men or officers
    c. General public and press must be excluded

Instructor's Notes

C. CONDUCTING A POST-MORTEM

***EXPLAIN** that one pattern will not fit all departments, however, each department should establish and follow a selected plan for conducting a post-mortem.*

1. Receiving the Call
    a. Was there anything unusual about it?
    b. Did the box recorder work properly?
2. Answering the Call
    a. Was a different route taken?
    b. Was there an unusual traffic problem?
    c. Is there a better route?
3. On Arrival
    a. Were there any unusual circumstances?
    b. Extent of fire
    c. Rescue
        (1) How many persons involved?
        (2) How was each rescue made?
        (3) Disposition of victim?
    d. Color of flame?
    e. Color, odor and density of smoke?
    f. Preplanning
        (1) Was preplan used?
        (2) Was it necessary to deviate from same?
        (3) If so, why?
4. Equipment
    a. What equipment was used?
    b. Was it the proper equipment?
    c. Was it in proper place and in good working order?
    d. Was the proper hydrant used?
5. Control of Family and the Public
    a. Outstanding difficulties and action taken for same
    b. Traffic problems due to hose lays
6. DISCUSS Origin and Cause of Fire
7. DISCUSS Possibility of Arson
8. Other Fire Fighting Tactics to be Reviewed
    a. Size-up
    b. Exposures
    c. Confinement
    d. Extinguishment
    e. Salvage
    f. Ventilation
    g. Overhaul
    h. Pick-up
9. Results - Recommendations Resulting from the Post-mortem Should be Carried Out Through Proper Channels

***DEVELOP** a post-mortem plan for the department to follow, with the class members participating, place on chalkboard.*

POST-MORTEM CONFERENCE

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STEP III - APPLICATION:

Have learners work Assignment Sheet No. 23 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOWUP:

REVIEW Assignment Sheet No. 23, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #24

FIRE DETECTION AND ARSON INVESTIGATION

OBJECTIVES:

1. To understand why fire investigations are considered to be an integral part of fire department operations.
2. To learn the necessity and value of fire report forms in expediting fire investigations.
3. To become familiar with the various factors involved in determining the cause of a fire.
4. To be made aware of the fact that Arson Dection is a composite matter and many factors are involved in its determination and solution.
5. To discuss the Laws of Ohio pertaining to arson, incendiarism, inspection, and etc., concerned with the protection, safety, and welfare of the people.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Available charts, forms, or reports dealing with subject

REFERENCE:

Fire Service Training (text), Chapter 24, pp. 318-330.

Instructor's Notes STEP I - INTRODUCING THE LESSON:

The investigation of fires is the basis for efficient fire prevention and fire protection operations. The accurate determination of the cause of fire, the spread of fire, and the application of manpower tools and equipment at the scene, are all conducive to the prevention and control of similar occurrences in the future. Intelligent fire investigation is the ground work for detecting arson and securing evidence necessary for proof of conviction of arsonists.

One of the many responsibilities of a fireman is to become proficient in detecting and assisting in the determination of the cause of fire. Even though the protection of life and property are of primary importance when arriving at the fire, careful observation of existing, and extenuating circumstances during extinguishment will in many instances lead to a solution of the cause and origin of the fire.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. FIRE REPORTS

***EXPLAIN** why the source and amount of information provided about a fire are important in arriving at a solution.*

1. Extent of report
    a. Should be relative to importance of alarm
2. Extent of fire
    a. Only 10% of fires represent 90% of losses, nevertheless, every fire should be checked
3. Nature, rapidity of spread, extent, unusual circumstances
4. Do not overlook small or trivial fires
    a. Quick extinguishment may disclose information for future situations
5. The term "undetermined" may be used if positive cause of the fire is not established
    a. "Undetermined" cause is sometimes an excuse for lackadaisical investigation

    REFER** learners to Figs. 5a & 5b, pp. 18-19, as one example of fire report. **DISCUSS.
6. EXPLAIN that local policy will govern the responsibility for making out fire reports

    If possible, have the chief of the department explain local procedures on making report.
7. Forms must be a practical compromise between one which is all-inclusive, and one which can be completed quickly
    a. Items generally covered:

    ***REFER** learners to p. 319, col. 1, and review list. **DISCUSS** any additions and elaborate on items.*
8. SHOW how list can be grouped into five areas of responsibility

    ***PLACE** on chalkboard.*

    a. Alarm office
    b. Company Run Report
    c. District or battalion chief, etc.
    d. Inspector, investigator, warden, etc.
    e. Arson investigator or bureau

    f. EXPLAIN how this responsibility may be delegated in smaller departments
    g. Nevertheless, whoever makes out report must decide and indicate need for further investigation

B. DETERMINING THE CAUSE

EXPLAIN - Because of the great variance in size, intensity, structural conditions, exposures, extinguishment, etc., of

Instructor's Notes

fires, it is obvious there can be no set rule or procedure to pin point the cause of every fire. However, there are several factors common to all of them which firemen should be familiar with to facilitate efforts to determine the cause. These are:

1. Color of smoke and flame
    a. Burning substance can often be identified by color emitted during burning process
2. Odors connected with fire
    a. Gasoline, alcohol, insulation, chemicals, solvents, etc., have distinct odors which can be recognized
3. Size, intensity and spread
    a. Unusual size of fire in short period of time may indicate artificial acceleration
    b. Intensity may indicate added fuels or compounds
    c. Rapid spread may indicate abnormal means of travel
4. Methods of extinguishment
    a. Unusual difficulties encountered in extinguishing fire with normal agents
5. One or more fires involved due to:
    a. Natural spread by radiation, conduction, convection, vertical openings
    b. Unnatural spread, purposely employed to hasten destruction
6. Evidence indicating actual cause of fire
    a. In many cases not enough effort is made to determine the cause, because the investigator is not:
        (1) Interested in the work
        (2) Allowed or given enough time to devote to the investigation
        (3) Sufficiently trained about fires or fire causes
    b. Fires are assumed to be natural or accidental until proven otherwise
    c. This should not deter efforts to look for unnatural things during the investigation
    d. This leaves the investigator with two possibilities to consider:
        (1) If the fire resulted from accidental or natural causes, what indications and proof are available to substantiate his deductions
            (a) In this case the investigator must determine and place the responsibility for the fire from the evidence and facts either produced or available

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(2) If the fire is unnatural, and no logical explanation or physical evidence can be produced to indicate natural or accidental origin
   (a) In this case, the investigator must first establish the fact that the fire was not started by accidental or natural causes
   (b) Thus, further investigation becomes necessary, and additional facts and information must be obtained to determine and place responsibility for the cause of fire
   (c) This involves another phase of fire investigation, namely, arson detection

C. ARSON DETECTION

1. Up to this point it is evident that the six factors previously discussed can be applied in any fire investigation
2. However, when the facts and information indicate arson has been committed, it becomes a crime punishable by law
3. Only by diligent effort by fire department personnel can fires of criminal origin be determined
   a. The person or persons responsible for them be apprehended, charged and convicted
4. In most cases, proof of arson depends greatly on circumstantial and indirect evidence
   a. Thus, it is the responsibility of firemen at any fire to become proficient in their ability to recognize, gather, and compile any evidence, mentally and/or physically that might indicate arson
   b. In short, his responsibility is arson detection rather than arson investigation
5. Additional factors to be considered in determining the cause of fire are:
   a. Locked doors and windows
   b. Broken doors, windows, or locks, or signs of forcible entry
   c. Unusual or suspicious action by persons on scene
   d. A car observed at several fires, or one rapidly leaving the scene of a fire
   e. Unnatural or unusual situations or conditions in buildings
   f. Unnatural burning and char of wood involved in fire
   g. Unnatural burning underneath floors
   h. Oil soaked materials
   i. Heating equipment condition

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j. Tracks, footprints and fingerprints
k. Flammable liquid containers
l. Unusual residues from wax, paraffin, chemicals, acids, etc.
m. Mechanical, electrical, or chemical timing devices
n. Open or disconnected fuel lines to stoves or heating equipment
o. Removal of valuable and personal articles prior to fire

6. Although the above list is somewhat comprehensive, it does not provide all the answers
7. Experience, knowledge, and ability will contribute to the success and desire of fire personnel to investigate the circumstances
8. Preserving and Safequarding Evidence
    a. Precautions to be exercised in firefighting:
        (1) Careless use of hose streams
        (2) Salvage operations
        (3) Recognition of situation
    b. Use of photography to show conditions
        (1) Time factor
        (2) What or what not to photograph
    c. Collection and preservation of evidence
        (1) Carefully collected, initialed, and identified
        (2) Proper containers
        (3) Evidence that cannot be removed must be protected by:
            (a) Guarding area
            (b) Barricading area
            (c) Use of authorized personnel
9. Records and Observations

STRESS value and importance of using note book to record significant and important data, and to introduce facts. Items should include:

a. Date
b. Time of alarm
c. Time of arrival at fire
d. Address of fire location
e. Description of building
f. Description of fire
g. Unusual conditions and circumstances
h. Location and description of clues and evidence
i. Names of owner or occupants contacted on premises, and brief notes on conversation
j. Names and addresses of witnesses or persons questioned, and notes on conversation
k. Sketches or floor plans to supplement descriptions

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l. Location and condition of doors and windows
m. Insurance data (company, agent, amount)
n. Names and address must be complete and recorded accurately, as to spelling, street, avenue, etc.

***DISCUSS** any examples or experiences which will illustrate the importance and necessity of any or all of the above items.*

10. Court Appearance, Decorum and Procedure

***STRESS** the value and importance of the following "do's" and "don'ts" in presenting an arson case in court:*

a. Proper dress and grooming
b. Qualifications as a witness
c. Be thoroughly familiar with your testimony
   (1) Refer to notebook and do not trust to memory
d. Truthfullness and fairness to all concerned
e. Stick to facts, and not hearsay
f. Proper respect for court defendant and attorneys
g. Speak clearly, precisely, and positively
h. Do not be overzealous or overanxious
i. Control temper under any circumstances
j. Do not discuss case with unauthorized persons
k. Have question restated or rephrased if not clearly understood
l. Original notes taken at the fire scene during the investigation may be used for reference
m. Identification of evidence must be positive
n. Importance of circumstantial evidence when properly introduced

***DISCUSS** examples or personal experiences to illustrate situations relative to any or all of the above items.*

D. LAWS OF OHIO - FIRE AND ARSON INVESTIGATION

***EXPLAIN** to learners that this subject is highly technical and controversial in many instances. The **PURPOSE** at this time is to merely **INDICATE** and **POINT OUT** the many facets of the law that deal with this important phase of fire protection as a whole, in the State of Ohio.*

1. Laws against arson and incendiarism
2. General powers and duties of the Division of State Fire Marshal
3. Local communities can supplement these statutes
   a. In accordance with their own needs and desires
   b. By legally adopting any laws or ordinances which are necessary for the protection of the lives and properties of their citizens

***REFERENCE** can also be made to the various pamphlets issued by the Division of State Fire Marshal pertaining to the subject. **REFER** class to the Fire Service Training (text), pp. 323-330, **DISCUSS** the various items listed if time permits.*

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STEP III - APPLICATION:

Have learners work Assignment Sheet No. 24 in the Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

REVIEW Assignment Sheet No. 24, re-teach any portion of lesson not thoroughly understood.

TEACHING GUIDE #25

INSPECTIONS

OBJECTIVES:

1. To point out to the learner that the protection of life and property is a very comprehensive obligation, and cannot be accomplished solely on the basis of the fire extinguishing potential of a fire department.
2. To acquaint the learner with the importance and value of a fire inspection program.
3. To familiarize the learner with the legal aspects involved in promoting, conducting and enforcing a fire inspection program
4. To present ideas and suggestions which will aid fire inspection techniques

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Samples of inspection forms, outlines, etc.
3. Copies of fire inspection or fire prevention material from National Board of Fire Underwriters, National Fire Protection Association, State Fire Marshal's Office, Ohio Inspection Bureau, and various fire insurance companies

REFERENCE:

Fire Service Training (text), Chapter 25, pp. 331-378.

Instructor's Notes

STEP I - INTRODUCING THE LESSON:

Efficient and well organized fire departments have realized that in order to provide a full measure of service to the people in their community, efforts must also be directed to the prevention of fires as well as to their extinguishment. Consequently, fire departments include fire inspection work as one of their responsibilities. Good inspections not only prevent fires, but by observation present opportunities to study and plan, resulting in the more efficient extinguishment of fires. The average businessman and property owner is not trained to recognize fire hazards, a fire department which has been trained in this direction, can render a valuable service to the community.

STEP II - PRESENTING THE LESSON:

A. VALUE AND PURPOSE OF INSPECTIONS

1. Fire department inspections will be of value to members

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of the department by:

a. Aiding in rescue work
b. Determining fire fighting procedure
c. Preventing spread of fire
d. Aiding in self-preservation of firemen
e. Providing knowledge of private fire protection equipment
f. Aiding in fire prevention
g. Determining causes of fire
h. Stimulating cooperation between the owners and occupants and the fire department

2. DISCUSS each of the preceeding items in greater detail
    a. Aiding in rescue work
        (1) First duty to protect life
        (2) Value of life vs. value of property
        (3) Firemen should know:
            (a) Where people live
            (b) Where people work
            (c) Where people assemble
        (4) EMPHASIZE the fact that inspections are the best means of obtaining this information
            (a) Inspections and surveys should be made periodically
    b. Determining fire-fighting procedure
        (1) Intelligent fire fighting depends on previous knowledge of building and contents
        (2) Too late to plan procedure after fire occurs
        (3) Desirable to have pre-determined plan of action
        (4) The following related information can be acquired by inspection:
            (a) Type of building and occupancy
            (b) Life hazard involved
            (c) Rescue problems
            (d) Entrance and exit facilities
            (e) Methods required for forcible entry
            (f) Exposure protection
            (g) Locations of hydrants and water supply
            (h) Sprinklers, standpipes, and other protective devices
            (i) Probable hose lines needed
            (j) Ventilation
            (k) Salvage requirements
            (l) Potential starting point of fire
            (m) Potential extension of fire
        (5) A summary of these factors thereby indicates their importance in terms of fire extinguishment

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and protection of life and property

- c. Preventing spread of fire
    - (1) The natural course is to follow the line of the most highly combustible material or the easiest means of travel
        - (a) Basement fire extension
        - (b) Open partitions, elevator shafts, chutes, ducts, etc.
    - (2) Exposure fires
        - (a) Unprotected doors, windows, or other openings
        - (b) Anticipate travel by inspection of premises
    - (3) Importance of preventing spread of fire
        - (a) Protecting openings
        - (b) Emphasizing importance to owners and occupants
- d. Aiding in the self-preservation of firemen
    - (1) No building is worth a fireman's life
    - (2) Accidents and death have often occurred because a fireman was unfamiliar with:
        - (a) Open elevator shafts
        - (b) Live wires
        - (c) Falling of flimsy walls, ceilings, or partitions
        - (d) Unfamiliarity with exits
    - (3) Inspection of buildings will indicate the potential life hazards of fire fighters
- e. Providing knowledge of private fire protection equipment

LIST the following equipment on chalkboard.

Fire extinguishers
Standpipe systems
Hose
Sprinkler systems
Private Water Supply
Alarm systems
Any others

- (1) Installed for two reasons
    - (a) Aids in manual extinguishment
    - (b) Provides automatic extinguishment
- (2) Because of infrequent use, inspections are necessary to check condition and operation
- (3) Effective also for
    - (a) Safety of occupants
    - (b) Makes fire fighting less difficult
- (4) Inefficient or ineffective equipment is worse than none at all

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- f. Aiding in fire prevention
  - (1) Majority of fire departments now stress fire prevention
  - (2) Prevent fires by eliminating fire hazards
    - (a) By building inspections
    - (b) Recommendations to remove or eliminate hazards
- g. Determining cause of fire
  - (1) Every fire teaches a lesson
  - (2) Knowledge of fire causes is essential to effective fire prevention
  - (3) Without knowledge, inspections are a waste of effort
  - (4) It is sometimes difficult to determine cause after fire occurs
    - (a) Hazardous condition has been consumed
    - (b) Evidence has been destroyed
  - (5) Familiarity with existing hazards makes it possible to anticipate causes
  - (6) Thorough inspections will:
    - (a) Determine causes of fire
    - (b) Indicate arson when causes are unusual
    - (c) Aid in recognizing and preserving evidence
    - (d) Prevent future fires resulting from same cause
- h. Stimulating cooperation between owners and occupants and the fire department
  - (1) Interest by department in preventing and controlling fires should be made known
  - (2) Fire inspector should:
    - (a) Inform building owners and occupants of availability of inspection service
    - (b) Emphasize need for calling department in case of fire
    - (c) Advise on matters pertaining to fire prevention and protection
  - (3) The greater the effort, the higher will be the standing of the fire department in the community

B. AUTHORITY FOR MAKING INSPECTIONS

1. Such authority is derived from two sources
   - a. Local ordinances
   - b. State law

DISCUSS each of the preceeding items in greater detail.

2. Local ordinances
   - a. Any city or village may pass ordinances, adopt codes,

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establish authority for inspections

b. Adopted in accordance with local conditions

c. Data and material for structuring codes can be procured from:

(1) National Board of Fire Underwriters
(2) National Fire Protection Association
(3) Underwriters Laboratories
(4) Factory Mutual Engineering Division
(5) Ohio Inspecting Bureau
(6) State of Ohio Department of Industrial Relations, Division of Factory and Building Inspections
(7) Division of State Fire Marshal

***INFORM** class that mailing addresses for these sources are given on p. 333, Fire Service Training (text).*

***DISCUSS** or have chief **DISCUSS** any local ordinances in effect which pertain to fire inspection practices.*

2. State Law

a. Under the general powers and duties of the Division of State Fire Marshal, the authority for making fire inspections is stated in the following sections of the State of Ohio Code:

***REFER** class to pp. 331-335, Fire Service Training (text), **DISCUSS** with learners each of the following sections of the Code:*

(1) Duties and powers of fire marshal and assistants
(2) Investigation of cause of fire
(3) Right to examine buildings, premises, and vehicles
(4) Appeal to fire marshal; hearing
(5) Appeals
(6) Prohibition against non-compliance with order
(7) Effect of failure to comply with order
(8) Prohibition against failure to instruct pupils in fire drill

b. While it is considered desirable to give the fire department inspection authority under local ordinance

(1) It can be safely assumed that any department has sufficient authority to conduct fire inspection services in the community under state laws

C. PERMITS AND LICENSES

1. RELATE the importance and merit of a permit and licensing system, for controlling special hazards in terms of:

a. Pre-knowledge of operation

b. Intent of operation

c. Determines fire fighting procedure

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d. Maintains supervision and control

e. Size of department determines how and by whom, authority and jurisdiction shall be exercised

REFER learners to pp. 366-369, Figs. 13, 14, 15 & 16, Fire Service Training (text), and DISCUSS material.

D. DEPARTMENT INSPECTION PROCEDURES

1. Standard procedure cannot be established for all departments because of variances in:
   - a. Organization
   - b. Local laws and ordinances
   - c. Enforcement regulations
   - d. Inspectional functions by various local divisions of government
2. Good results can be obtained by having:
   - a. Effective administration and control
   - b. Qualified and trained inspection personnel
   - c. Continuous inspection program

E. COMMON CAUSES OF FIRE

REFER learners to table on Common Causes of Fire, p. 336, Fire Service Training (text), and DISCUSS contents. INDICATE items which pertain particularly to highest frequency, and largest fire losses. STRESS "Unknown" implications.

F. PRINCIPAL STRUCTURAL DEFECTS INFLUENCING FIRE SPREAD

1. Various factors which are of concern in determining or influencing fire spread are:
   - a. Horizontal spread
     - (1) Fire walls
       - (a) Too few in attics
       - (b) Too few in basements
       - (c) Too few in other stories
       - (d) Substandard construction
     - (2) Fire wall openings
       - (a) No protection provided
       - (b) Open or inoperable doors
       - (c) Substandard protection
     - (3) Combustible interior finish
       - (a) Fiberboard
       - (b) Other various materials
       - (c) Oil soaked floors
   - b. Vertical spread
     - (1) Stairwells not enclosed
     - (2) Open elevator shafts

Instructor's Notes

- (3) Non-firestopped walls
- (4) Conveyor machinery openings
- (5) Substandard stairwell enclosure
- (6) Pipe openings not closed
- (7) Substandard elevator shaft enclosure
- (8) Other openings not protected or substandard

c. Spread to exposures

- (1) Combustible construction and no exposure protection
- (2) Substandard party walls
- (3) Interconnecting openings
- (4) Type of windows
- (5) Yard storage between buildings

G. PRINCIPAL PRIVATE FIRE PROTECTION DEFECTS INFLUENCING FIRE SPREADS

1. Various factors which should be considered when fire protection equipment is involved are:
   - a. Sprinkler protection
     - (1) No sprinkler system
     - (2) Complete or partial sprinkler system
       - (a) Unsatisfactory performance
       - (b) Hazard too severe for system
       - (c) Water supply inadequate
       - (d) Valves closed for miscellaneous reasons
       - (e) Explosion damage potential
       - (f) Valves closed too soon by personnel
       - (g) Fire originating in unsprinklered area
       - (h) Proper supervision and maintenance of system
   - b. Fire detection
     - (1) No watchman or automatic detection
     - (2) Unsatisfactory watchman service
       - (a) To detect fire promptly
       - (b) Area of patrol (inside and outside)
       - (c) Size of area patrolled
     - (3) Inadequate or unapproved automatic detection
   - c. Fire alarm transmission
     - (1) Transmission delay due to:
       - (a) Occupants fighting fire
       - (b) Telephone inaccessible
       - (c) Possibility of telephone lines becoming burned and inoperable
       - (d) Orders to watchman relative to fighting fire

Instructor's Notes

- d. Fire brigade
  - (1) No fire brigade
  - (2) Insufficient equipment
  - (3) Organization and training
  - (4) Unsatisfactory performance and response
- e. Standpipe and hose systems
  - (1) No system
  - (2) Unsatisfactory and inadequate
  - (3) Accessibility and usability
  - (4) Maintenance and supervision
- f. Special extinguishing systems
  - (1) No system
  - (2) Unsatisfactory and inadequate
  - (3) Maintenance and supervision
- g. Portable fire extinguishers
  - (1) No fire extinguishers
  - (2) Wrong type for class of fire
  - (3) Maintenance and supervision
  - (4) Training of personnel in operation

H. POINTS TO BE CONSIDERED BEFORE MAKING THE INSPECTION

1. Common sense and friendly attitude
2. Appropriate dress and equipment
   - a. Uniform, cap, badge
   - b. Clean overalls
   - c. Flashlight
   - d. Notebook and pencil
   - e. Camera
3. Additional local requirements
4. Prepare for thorough and efficient inspection
5. Check information and records from previous inspections
6. Contact person in charge for permission
   - a. Although not legally necessary, it creates better relationship
7. Identify self properly
8. EXPLAIN reason and benefits of inspection
9. Request company representative to assist
   - a. Shows courtesy
   - b. Source of information
   - c. Acts as guide

I. INSPECTION TECHNIQUES

1. Places of public assembly when:
   - a. Open, and in operation
   - b. Closed, and not in operation

Instructor's Notes

2. Industrial Plants
   a. Orientation trip of premise
      (1) To fix in mind general relationship and location of buildings to one another and to adjoining property
   b. Roof of tallest building to visualize area
   c. Obtain plans of grounds and buildings if possible
   d. Plans or sketches of property should be made on first inspection:
      (1) Duplication is eliminated on re-inspections
      (2) Changes or additions can be added
      (3) Completeness of plan rests on ability of person making it
      (4) Should be made with neatness and accuracy

REFER learners to Figs. 1-2, pp. 340-341, Fire Service Training (text), and DISCUSS Standard Plan Symbols and Property Plan Record.

3. General Size-up of Outside Conditions
   a. Location of fire hydrants
   b. Fire escapes
   c. Standpipes and sprinkler connections
   d. Accessibility of fire apparatus
   e. Fire walls
   f. Other factors involved with fire protection
4. Where to start inspection is immaterial
5. How inspection is done is important
   a. Orderly procedure
   b. Thorough coverage of each floor

6. 6. Inspection Forms
   a. Facilitate inspection

REFER learners to Figs. 5-23, pp. 350-378, Fire Service Training (text), and DISCUSS the various inspections forms illustrated. Those can be supplemented with others if available.

   b. Forms are subject to modification in accordance with local conditions
7. Some important things to look for when inspecting mercantile and industrial buildings

REFER learners to items 1 thru 22 on p. 339, Fire Service Training (text), READ and/or DISCUSS. EXPLAIN this list is not all inclusive, as the hazards will vary in accordance with the occupancy.

8. After inspection is completed the inspector should:
   a. Have conference with owner or manager if possible
   b. Indicate and point out results of inspection
   c. Encourage individual to solve problems
   d. Offer suggestions for solution
   e. Obtain mutual agreement on matters
   f. Do not find fault or criticize

Instructor's Notes

g. Make reasonable and practical recommendations
h. When in doubt, secure expert advice, instead of making foolish recommendations
i. Make certain all items, major or minor have been covered
   (1) A minor hazard could result in a major fire
j. Remember, the inspector is there to assist in preventing fire, and to be better informed to fight fire, if one occurs
k. Leave a favorable impression, as succeeding inspections will depend on your actions

J. THE FOLLOW-UP ON INSPECTIONS
1. Will assure effectiveness of inspection
2. Keep clear and concise notes for future reference
3. Inform owner or occupant when recheck is to be made
4. When definite date is made, keep it
   a. Emphasizes enforcement
   b. Creates respect for program
   c. Indicates sincerity in expediting fire prevention and protection matters

K. ENFORCEMENT HINTS
1. Legal action taken only as last resort
2. Tact and diplomacy usually gains results
3. Whatever the case, recommendations must be complied with
4. Violations under jurisdiction of other local departments should be reported to proper authority
5. Some success achieved through cooperation of local fire insurance agent
6. Where local ordinances are not in force, Chief of department can act under state laws
7. Chief of department can also report conditions to Division of State Fire Marshal for enforcement

L. TYPES, FREQUENCY AND TIMES OF INSPECTIONS
1. Dwellings Inspections
   a. Most fires occur in dwellings
   b. Good results accomplished by home inspections
      (1) Requires planning, preparation, and cooperation of local:
         (a) Fire prevention committee
         (b) Chamber of Commerce
         (c) Newspapers, Radio, Television, etc.

Instructor's Notes

- (d) Advertising with posters, stickers, letters, etc.
- (e) P.T.A., Churches, clubs, etc.
- (f) Use of home inspection blanks through school children

REFER** learners to Fig. 3, pp. 343-344, Fire Service Training (text), and **DISCUSS.

c. Legally, a home cannot be entered without permission

d. Generally, firemen are welcomed

e. When making home inspections, firemen should:
- (1) Work in pairs
- (2) Select proper time of day
- (3) Ask permission to make inspections
- (4) Explain purpose and nature of visit
- (5) Ask to be accompanied by occupant
- (6) Leave fire prevention pamphlets

f. Usually made in conjuction with Fire Prevention Week

g. Benefits are significant after first year

h. Points to notice during inspection of outside
- (1) Roof condition
- (2) Chimney condition
  - (a) Supports
  - (b) Loose bricks
  - (c) Open joints or cracks
- (3) Yard condition
  - (a) Accumulation of grass, leaves, paper
  - (b) Other combustibles in yard or under porches porches
- (4) Condition of garages and sheds
  - (a) Cleanliness
  - (b) Maintenance

i. Points to notice during inspection of basement
- (1) Accumulation of combustibles
  - (a) Paper
  - (b) Oily rags
  - (c) Discarded materials
- (2) Improper storage in general
- (3) Disposal of ashes
  - (a) Combustible containers
  - (b) Against wood partitions
- (4) Heating equipment and pipes
  - (a) Ceiling clearances
  - (b) Partition clearances
  - (c) Condition of smoke pipes

Instructor's Notes

(5) Gas appliances
  (a) Condition of piping
  (b) Rubber tubing used
  (c) Automatic controls without thermostat
(6) Oil burning installations
(7) Chimneys defects
  (a) In contact with wood
  (b) Unused openings not properly closed
  (c) Clean-out door at base of chimney
  (d) General condition, cracks, loose bricks, etc.
(8) Work rooms
  (a) Shavings, waste material
  (b) Storage of flammables (paints, thinners, etc.)
(9) Fire stops in basement

2. School inspections

***EMPHASIZE** life hazard involved.*

a. Inspections should be:
  (1) Made by qualified inspectors
  (2) Made on monthly basis
  (3) Accompanied by custodian or administrator

b. Self-inspection blanks can be used

REFER** learners to Fig. 4, pp. 347-348, Fire Service Training (text), and **DISCUSS.

c. Points to notice during inspection
  (1) Condition of housekeeping
    (a) Handling and disposal of waste paper
    (b) Unnecessary accumulation of materials
    (c) Type of disposal containers in shops
  (2) Heating equipment
    (a) Proper clearances from combustible material
    (b) Condition of smoke pipes and heating plant
    (c) Automatic controls
  (3) Electrical wiring
    (a) Unsafe extension cords
    (b) Unsafe installations
    (c) Broken fixtures
    (d) Size of fuses
  (4) Ventilating system
    (a) Improper storage of combustible materials
    (b) Damper protection
    (c) Controls for fans
  (5) Fire extinguishers and standpipe systems
    (a) Number and spacing

Instructor's Notes

        - (b) Maintenance
        - (c) Fire hose and nozzles
    - (6) Fire doors
        - (a) Where required
        - (b) Operating condition
    - (7) Fire alarm system
        - (a) Heard in all portions of the building
        - (b) Controls on each floor
        - (c) General condition
    - (8) Exit facilities
        - (a) Number and adequacy
        - (b) Operation and panic hardware
        - (c) Obstructions in stairways, corridors, fire escapes
        - (d) Type of glass in windows on or near fire escapes
    - (9) Fire drills
        - (a) Frequency
        - (b) Time required to vacate building
        - (c) Fire department notification in case of fire
        - (d) Definite system to determine all persons are out of building

3. Frequency and Time of Inspections
    - a. No standard policy
    - b. Local conditions control
    - c. Frequency depends on:
        - (1) Existing hazards
        - (2) Housekeeping
        - (3) Type of occupancy
            - (a) Industrial and commercial - at least four times yearly
            - (b) Dwellings - at least once a year
            - (c) Places of public assembly - at least four times yearly, or weekly or monthly when in use
        - (4) Target hazards
            - (a) At least six times yearly
            - (b) More often if conditions warrant
        - (5) Rubbish accumulations
            - (a) Weekly
    - d. Time depends on:
        - (1) Size and organization of department
        - (2) Working hours and activities of places or buildings concerned
        - (3) Sometimes necessary on week-ends or in evening, on prearranged basis

Instructor's Notes

(4) Holidays or special seasons require special attention, due to:
   (a) Excess stock
   (b) Excess rubbish
   (c) Less attention to fire prevention
   (d) Overcrowding

***REFER** learners to Fig. 5, p. 350, Fire Service Training (text), and **DISCUSS**.*

4. Additional Hints and Suggestions for Inspectors

***DISCUSS** and/or **ELABORATE** on the following items:*

a. Representation and action of inspector
b. Be careful but firm
c. Be friendly but not familiar
d. Make suggestions or recommendations to only those in authority
e. Provide duplicate copies to proper person
f. Name of inspector and date of inspection should always be noted on records
g. Do not argue. Refer disputes to Chief of department
h. Be fair and impartial in judgment
i. Knowledge of work will command respect
j. Inspectors importance is measured in terms of results obtained
k. Realize the importance of the work, and consider the duties seriously
l. Thorough and regular inspections are the criteria for obtaining good results
m. Good public relations result from courteous treatment

5. Inspection Forms

***REFER** learners to pp. 350-378, Fire Service Training (text). Although some of these forms have been referred to previously, it may be well to cover this section and **DISCUSS** those not mentioned specifically during the lesson. These forms may be used as samples by the local department in developing forms which are adapted to local policy, rules, and regulations.*

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 25 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOW-UP:

***REVIEW** Assignment Sheet No. 25, re-teach any portion of lesson not thoroughly understood.*

TEACHING GUIDE #26

RADIATION HAZARDS

OBJECTIVES:

1. To stress that radioactive materials must be respected.
2. To acquaint fireman as to where radioactive materials may be generally located and used.
3. To teach the firemen that this hazard must be accepted and dealt with properly.
4. To orient firemen with the problems of radiation hazards in general and to prepare them for more specialized training.

TEACHING AIDS:

1. Chalkboard, chalk, and eraser; or chart pad
2. Radiation monitoring instruments - (if available)
3. Used radium watch faces
4. Radiation warning signs

REFERENCE:

Fire Service Training (text), Chapter 26, pp. 379-404.

Instructor's Notes STEP I - INTRODUCING THE LESSON:

The purpose of this chapter is to orient firemen with the problems of radiation hazards in a peacetime situation. It is to serve as a basis for acquainting firemen with the problems of radiation hazards in general, not to train them to become radiation specialists, nor to qualify them to deal effectively with the hazards.

The values of radiation and radioactivity to man are of such an important nature, that the atomic era is here to stay in spite of the fact that there are certain definite hazards involved in their use.

The number of users of radioactive materials increase each day and will continue to become more prevalent, therefore it is very important that the firemen be aware of all the facts about these materials if they wish to perform their duties and responsibilities in a safe and efficient manner.

Instructor's Notes

STEP II - PRESENTING THE LESSON:

A. BENEFICIAL USES OF NUCLEAR ENERGY

1. A radioisotope, radioactive material, and a radiation emitter are similar
    - a. Each releases energy from the center or nucleus of the atom

      REFER learners to Fig. 1, p. 379, Fire Service Training (text):
    - b. This energy can only be detected by electrical or chemical means
2. Diagnosis of disease by radioactive tracers
    - a. Testing the thyroid gland
        - (1) The thyroid gland absorbs iodine
        - (2) Radioactive iodine is still chemically iodine and will still go to the thyroid gland
        - (3) By using a radioactive detecting devise the doctor can tell if the gland is functioning properly
        - (4) The radioactive iodine will not harm the patient or help heal the gland
        - (5) It is just a tool used by the doctor to diagnose whether or not the gland is working properly

          REFER learners to Fig. 2, p. 380, Fire Service Training (text) and EXPLAIN following:

          Radioiodine is mixed with water - A in Fig. 2
          Patient drinks contents of glass -B in Fig. 2
          Thyroid gland absorbs radioactive iodine - C in Fig. 2
          Radiation is then measured - D in Fig. 2
3. Radioactive tracers in animal and agricultural food production
    - a. Calcium and phosphorus tracers provide information on live stock feeding

      REFER learners to Fig. 3, p. 380, Fire Service Training (text) and EXPLAIN.
    - b. Tracers are also used to check insecticide compounds
    - c. Radioactive isotopes prove some fertilizers can be absorbed through the leaves of plants

      REFER learners to Fig. 4, p. 381, Fire Service Training (text) and EXPLAIN.
4. Measuring metal wear
    - a. Check engine wear

      REFER learners to Fig. 5, p. 381, Fire Service Training (text) and EXPLAIN.
        - (1) Piston ring is made radioactive
        - (2) As piston ring wears the radioactive iron is freed into the oil

Instructor's Notes

        (3) Detector is used to measure radioactive iron in the oil
    5. Liquid flow traced by radioactivity
        REFER learners to Fig. 6, p. 382, Fire Service Training (text), and EXPLAIN.
    6. Radiography of high pressure equipment
        REFER learners to Fig. 7, p. 382, Fire Service Training (text) and EXPLAIN.
    7. Thickness guaging and quality control
        REFER learners to Fig. 8, p. 382, Fire Service Training (text) and EXPLAIN.
    8. Elimination of static electricity
        a. Radioisotopes makes air electrically conductive which provides an invisible path through which the electricity will be grounded
            (1) Grounding the equipment is therefore not necessary
    9. Treatment of disease by radiation
        REFER learners to Fig. 9, p. 383, Fire Service Training (text) and EXPLAIN.
    10. Chemical changes and processing by radiation
        a. When polyethylene was first developed it would not withstand boiling
        b. Now at the proper point in manufacturing it is subjected to radiation which knocks out a couple of hydrogen atoms which go off as gas
        c. With this chemical change in the material polyethylene can now be boiled, so it can be made steril
    11. Electrical Production by Radiation
        a. This is the direct production of electricity from the energy released by radioactive atoms
            (1) Small atomic battery

B. LOCATING NUCLEAR ENERGY HAZARDS
    1. Natural radioactive materials, such as radium, are not under Atomic Energy Commission regulations
    2. Some states do have regulations
    3. All man made radioactive materials are controlled by licensing by the A.E.C.
    4. Radioactive materials may be found in:
        a. Universities
        b. Industrial Laboratories
        c. Industrial Plants
        d. Hospitals
        e. Doctors' Offices
        f. Atomic Power Plants
        g. Military Installations
        h. Transportation facilities
            (1) Vehicles
            (2) Depots
            (3) Trains
            (4) Boats
            (5) Planes
    5. Atomic Energy Commission notifies state health department of all persons licensed to use radioactive material within the state

Instructor's Notes

6. State is to notify municipal agencies
    a. Fire department
    b. Police department
7. State is to send letter to licensee suggesting he notify the local fire and police department of his possession of radioactive material
8. Fire departments should request from the state health department notification of A.E.C. licensees in their area
9. Radioactive materials may also be located by fire departments during building inspections

    SHOW SAMPLE or DRAW Fig. 10, p. 385, Fire Service Training (text) on chalkboard.

    a. This information should be placed on building inspection form
    b. A.E.C. will assist inspectors in getting into, so called, classified areas for inspection
    c. A good relationship between the fire department and the company will usually aid in providing firemen with necessary information

C. PROBLEMS OF RADIATION

1. Radiation risk to the fire service should be evaluated
    a. Radiation should not be unnecessarily feared nor totally ignored
    b. It must be properly related to the many other common hazards faced daily by a fireman in his profession
2. Radiation exposure can do apparent damage to the body if received in sufficient quantity
    a. Within certain limits the body can repair enough of the biological damage
        (1) So that there is no apparent effect on the person
    b. Therefore people can be exposed to some radiation to accomplish necessary work
        (1) Without any apparent effect on their ability to continue living a normal life
3. Mankind is being constantly exposed to some radiation
    a. This is "background" radiation which occurs in nature
        (1) Cosmic radiation from outer space
            (a) Level of cosmic radiation in Denver approximately twice that of New York
        (2) Radioactive materials in the earth
            (a) Also present in building materials
        (3) Radioactive naterials in the body such as radioactive carbon, potassium, radium, etc.

Instructor's Notes

- b. Through commonly used radiation machinery, mainly X-ray
- 4. Excessive radiation exposure to the human body:
  - a. Produces radiation sickness
    - (1) A massive overdose of long-range, highly penetrating type of external radiation to the whole body or a substantial portion thereof
      - (a) Causes nausea, vomiting, diarrhea, hemorrhage, and lowering of the body's resistance to infection
  - b. Produces radiation injury
    - (1) An overdose of short-range, less penetrating type of external radiation to a localized portion of the body
      - (a) Can cause injuries such as burns, loss of hair, and skin lesions
  - c. Produces radioactive poisoning
    - (1) Dangerous amounts of certain types of radioactive materials, usually in finely divided particles, liquid or vapor form, when introduced into the body by breathing and swallowing, through wounds, or by absorption through the skin
      - (a) Can cause such diseases as anemia and cancer

        ***REFER** learners to Fig. 13, p. 390, Fire Service Training (text) and **EXPLAIN**.*
  - e. DISCUSS genetic effects
- 5. To the fireman the problem of protection from radiation is in reality two distinct problems, external and internal radiation

***REFER** learners to Fig. 11, p. 388, Fire Service Training (text) and **EXPLAIN**.*

D. EXTERNAL RADIATION

- 1. External radiation comes from certain radioactive materials which are located outside the body
- 2. Types of external radiation hazards
  - a. Gamma radiation
    - (1) Long-range
    - (2) Highly penetrating

      ***REFER** learners to Fig. 12, p. 388, Fire Service Training (text),*
  - b. Beta radiation
    - (1) Short-range
    - (2) Low penetrating

Instructor's Notes

E. PROTECTION FROM EXTERNAL RADIATION

1. Protection from gamma radiation
   a. Time
      (1) Limit the time firemen are exposed
      (2) Fire fighting crews should be changed (not rotated)
      ***REFER** learners to Fig. 14, p. 391, Fire Service Training (text) and **EXPLAIN**.*
   b. Distance
      (1) The radiation level decreases rapidly as the distance form the source increases
      ***REFER** learners to Fig. 15, p. 392, Fire Service Training (text) and **EXPLAIN**.*
   c. Shielding
      (1) Highly dense material such as lead is best shield
      (2) Some shielding can be obtained from iron, water, concrete and mounds of earth
      ***REFER** learners to Fig. 16, p. 392, Fire Service Training (text) and **EXPLAIN**.*
      (3) Wood walls or the use of water streams from a fire hose offer practically no shielding
2. Protection against beta radiation
   a. Do not handle
   b. Wash off body promptly
   c. Limit exposure time

F. RADIATION DOES NOT MAKE THINGS RADIOACTIVE

1. People believe exposure to radioactive materials will make things radioactive
2. The only way things can be made radioactive is to place them in an atomic reactor or subject them to neutron bombardment
3. Smoke from fire involving radioactive material will not be radioactive, but may be contaminated with radioactive particles

G. RADIATION DETECTION

1. Radiation can not be detected by the human senses
   a. Seeing, smelling, tasting, feeling, hearing
2. Radiation must be detected by:
   a. Mechanical instrument
   b. Chemical instrument
   c. Electric instrument
3. Dose rate meters

Instructor's Notes

- a. The Geiger - Muller counter
  REFER learners to Fig. 17, p. 393, Fire Service Training (text).
  - (1) Measures only low levels of radiation
  - (2) Registers in milliroentgens
  - (3) Registers both gamma and beta radiation
    - (a) Beta may be filtered by closing metal shield on detector probe
  - (4) It may block out and give no reading in a high radiation field
- b. The ionization chamber detector
  REFER learners to Fig. 18, p. 393, Fire Service Training (text).
  - (1) Can measure high levels of radiation
  - (2) Registers in roentgens per hour
  - (3) Measures both gamma and beta radiation
  - (4) Is best type for fire department use
- c. To monitor alpha radiation special instruments are required
- d. All radiation detectors require skilled maintenance and calibration

4. Dosimetry
   - a. Instruments used to measure accumulated radiation exposure
     - (1) Film badges
       REFER learners to Fig. 19, p. 394, Fire Service Training (text).
       - (a) Film badges consists of special radiation sensitive film contained in a holder
       - (b) They can not be read directly
       - (c) Film must be developed and compared with control samples to determine exposure
     - (2) Pocket Dosimeters
       REFER learners to Fig. 20, p. 395, Fire Service Training (text).
       - (a) Pocket dosimeters are small sensitive instruments carried in one's pocket
       - (b) They can be read by holding up to the light
       - (c) Dropping may cause false reading

H. INTERNAL RADIATION AND PROTECTION

1. Internal radiation results from radioactive materials absorbed into the human body
2. Alpha radiation presents the greatest internal hazard
   - a. Very short-ranged, relatively heavy atomic particles
   - b. Has very little penetrating power
3. Internal radiation hazards may be found:
   - a. In industries where radioactive materials are processed

Instructor's Notes

(1) Rolling, stamping, milling, grinding and polishing

b. In laboratories where they are put in chemical solution

4. Radioactive material gets into body 4 ways
   - a. By breathing
   - b. By swallowing
   - c. Through breaks in the skin
   - d. By absorption through the skin
5. Protection from internal radiation hazards
   - a. Radioactive materials may be in any physical shape
     - (1) Dust
     - (2) Powders
     - (3) Liquid
     - (4) Gases
   - b. Masks
     - (1) Self-contained masks should be worn at all times
     - (2) A.E.C. plants use special filter-type masks
   - c. Proper removal of mask

     ***REFER** learners to Fig. 22, p. 397, Fire Service Training (text) and **EXPLAIN** step 1 thru 6.*

     - (1) Step 1 - Fireman leaves contaminated area keeping mask on and operating
       Step 2 - Fireman is washed off with hose stream
       Step 3 - Fireman removes turn out clothing, keeping mask on
       Step 4 - Fireman holds breath and removes mask
       Step 5 - Fireman should promptly wash hands and forearms
       Step 6 - Take shower at station
       - (a) Use plenty of soap
       - (b) Wash hair well
       - (c) Wash under arms well
     - (2) Mask, clothing and gloves should be left at control point

I. CONTAMINATION

1. Contamination is the dispersal of radioactive material, generally in finely divided particles, in liquid or vapor form, in any place where it is not desired, and may produce a hazard to personnel
2. The hazards from radioactive contamination may be from alpha, beta, or gamma radiation
3. Contamination control by setting up control lines

   ***REFER** learners to Fig. 23, p. 398, Fire Service Training (text) and **EXPLAIN**.*

Instructor's Notes

- a. These are physical lines
- b. Can be set up by using rope, ladder or hose
- c. Could be a door way of a room
- d. Contamination control point should be determined ahead of time if possible

3. Contamination spread by smoke and water

   ***REFER** learners to Fig. 24, p. 400, Fire Service Training (text).*

   - a. Contaminated smoke in large amounts can not be controlled
   - b. Small amounts may be controlled by ventilation and smoke ejectors
   - c. Water spray can be employed to settle radioactive material out of the smoke or air thus preventing it from spreading
   - d. Use minimum amount of water to extinguish fire
   - e. Small amount of water can be contained by sawdust, salvage covers, etc.
   - f. If large amounts of water must be used the area of contamination will be greater
   - g. The route of run off water should be checked because radioactive material will settle from the water
     - (1) Sewer catchbasins
     - (2) Sewers
     - (3) Disposal plants

4. Cleanup after fire or emergency should not be done where radioactive materials are involved
   - a. The licensee is responsible for cleanup

5. Decontamination
   - a. Decontamination of building is not the fireman's responsibility
   - b. Decontamination should be done by qualified specialists

J. FIRE DEPARTMENTS RESPONSIBILITIES IN THE NUCLEAR AGE

1. Radiation Safety Officer
   - a. Should be trained for each department
   - b. However, every fireman should have some knowledge of radiation hazard
2. Prefire Planning
   - a. Should be done with plant management
   - b. Better protection for plant
   - c. Better protection for firemen
3. Suggested Prefire Plan Card and Sketch

   ***DISCUSS** and **EXPLAIN** Fig. 25, p. 401, Fire Service Training (text).*

Instructor's Notes

Obtain information from a licensee in the area and present the information to class, having them record same on the Prefire Plan form.

K. GLOSSARY OF RADIATION TERMS

EXPLAIN - this is for the use of the learner to better understand some of the atomic energy terms.

STEP III - APPLICATION:

Have learners work Assignment Sheet No. 26 in Learner's Workbook.

STEP IV - CHECKING AND FOLLOWUP:

REVIEW Assignment Sheet No. 26, re-teach any portion of lesson not thoroughly understood.

APPENDIX

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 1

COMMUNITY FIRE DEFENSE

QUESTIONS:

1. a. Department willingness to use its means and facilities, b. Member's responsibility and obligation, c. Support and consideration of local officials, d. The community's responsibilities.
2. A grading schedule is a means of classifying municipalities, and rural communities and areas, with reference to their fire defenses and physical conditions.
3. a. Availability, b. Dependability, c. Reputation, d. Appearance, e. Personality, f. Cooperativeness, g. Job interest, h. Initiative, i. Mental stability, j. Aptitude, k. Leadership, l. Physical condition.
4. a. Fire prevention acitivities, b. Emergency squad facilities, c. Individual behavior and courtesy, d. Elimination of department strife or discord, e. Airing of department business in public, f. Company inspections.
5. To provide more apparatus, more equipment, and man power at the scene of the emergency.
6. Public Utilities, excavating or road equipment sources, radio and television stations, red cross, hospitals and their staffs, sheriff's office, highway patrol, local service departments, radiation monitoring services.
7. General fire department information, company records, training, apparatus, and fire prevention.

1. people, ravages, fire
2. citizens, governing
3. National Board of Fire Underwriters, Ohio Inspection Bureau
4. water supply, fire department
5. efforts, qualifications, every
6. public relations, fire department, people, community
7. fire defense, plan of operation
8. protection, safety, welfare
9. size, adequacy, personnel
10. report, information

1. False
2. False
3. True
4. True
5. False
6. True
7. False
8. False
9. True

Assignment Sheet No. 2

CHEMISTRY OF FIRE

QUESTIONS:

1. Combustion or burning is a chemical process accompanied by the evolution of light and heat.
2. The temperature at which a substance will catch on fire and continue to burn.
3. The temperature at which a flammable liquid gives off vapor sufficient to form an ignitable mixture with the air near the surface of the liquid or within the vessel containing the liquid.
4. Spontaneous ignition of a material is caused by the gradual development of heat due to a chemical change within the material.
5. Smoke is the result of incomplete combustion, therefore, some unburnt carbon is liberated as soot and carbon monoxide.
6. Fuel, oxygen, heat.
7. 21%
8. Below 16%
9. a. By cutting off the supply of oxygen through smothering so that the flame will consume or exhaust all of the oxygen around it. b. By displacing air with a noncombustible gas such as carbon dioxide or water vapor.
10. Explosions occur where flammable vapors, gases, or combustible dusts are mixed with air in proportions such as to produce very rapid oxidation of the entire mass when a source of ignition is provided.
11. The first explosion, involving dust which is already in suspension, dislodges dust from beams, ledges, etc., and forms a second cloud through which the secondary explosion propagates.
12. a. Grain-handling plants, b. Starch Manufacturing, c. Sugar refining, d. Woodworking, e. Sulfur crusing and pulverizing, f. Hard rubber recovery, g. Cork grinding, h. Aluminum, magnesium and other metal powder plants, i. Fertilizer plants, j. Powdered milk plants, k. Chocolate, cocoa and candy factories, l. Plastic, m. Textile works.
13. Many common flammable liquids and gases have very wide explosive ranges. Mixtures outside these limits are either too "lean" or too "rich" to explode. The too "lean" mixture is below the lower explosive limit since it does not have sufficient flammable vapor or gas in proportion to the amount of air, while the too "rich" mixture has too much flammable vapor or gas in proportion to the available air.

1. heat, fuel, oxygen
2. heated, combustible gas
3. flash point, flammable
4. method, extinguishment
5. rate, amount

ASSIGNMENT SHEET NO. 2 (Continued)

QUESTIONS:

6. flash fires
7. confinement, venting, suspension
8. handling
9. vapor, liquid, air
10. effective, reduction, saving

1. False
2. False
3. True
4. True
5. True
6. True
7. False
8. True
9. False
10. True

Answers for Assignment Sheet No. 3

CLASSIFICATION AND USES OF FIRE EXTINGUISHERS

QUESTIONS:

1. The ease of handling, the ability to provide the necessary extinguishing agent to put out the fire quickly and efficiently and the fact that extinguishers are ready for use when needed.
2. Class A - Fires in ordinary combustible materials such as wood, cloth, and paper. Class B - Fires in flammable petroleum products or other flammable liquids, greases, etc. Class C - Fires involving electrical equipment.
3. Numeral - The approximate relative fire extinguishing potential needed to extinguish standardized fires. Letter - The class of fire on which the use of the appliance is approved for most effective fire extinguishment.
4. Class A - Soda, acid, foam, water, loaded stream. Class B - Vaporizing liquid, foam, CO_2, dry chemicals, loaded stream. Class C - Vaporizing liquid, CO_2, dry chemicals.
5. a. Deterioration, b. Damage, c. Clogged orifices, d. Weight of cartridge, e. Condition of hose and gaskets, f. Filled to proper level, g. Proper pressure on gauge, h. Condition of parts, i. Weight of contents.

1. infancy, substitute, fire department
2. all, all
3. classifications
4. Underwriters Laboratories
5. maintenance
6. fully charged, efficient
7. corrosion, dangerous
8. pressure test, generated
9. charging, maintenance, operation

1. True
2. False
3. False
4. True
5. False
6. False
7. True
8. False

ANSWERS TO LEARNER'S WORKBOOK

Answers for Assignment Sheet No. 4

WATER AS USED IN FIRE FIGHTING

QUESTIONS:

1. Water absorbs the heat from both the heated gases and the burning material until the temperatures of both are reduced below the ignition point.
2. British Thermal Unit (B.T.U.)
3. A column of mercury "one inch high" exerts approximately equal pressure per square inch on its' base as will a column of water "one foot high".
4. Head pressure is the term used to describe the result of the operation of supplying water to a pumping unit when such units are connected to a fire hydrant or some other source of supply by pressure.
5. a. Solid stream, b. Broken stream, c. Spray or vapor stream, d. Water curtain, e. Master streams.
6. Rotary nozzle shall be attached to hose at place of service before making an opening into the fire area. Use a hose clamp if available, placing it on hose near the nozzle. Water should be started through the nozzle and inserted through the opening provided in the fire building until it hits bottom and then raised half way in order to obtain better coverage.
7. Divide the horizontal distance the nozzle is from the building by the story into which the stream is directed.

1. 50, 75
2. resistance
3. pump pressure
4. friction loss
5. 150
6. 50
7. fire streams
8. height
9. 1728

1. True
2. False
3. True
4. True
5. False
6. False
7. True
8. True
9. False

Assignment Sheet No. 5

FIRE HYDRANTS

QUESTIONS:

1. The grid should be strengthened.
2. a. Location, b. Date installed, c. Size main, d. Size lead in, e. Turns on left or right, f. Size and number of outlets, or any others listed in the manual.
3. Break type and standard type.
4. The break type hydrant if damaged will remain in the closed position due to the pressure in the main, the standard type will not.
5. To prevent surface water from entering the hydrant barrel.
6. Semi-annually -- April and October
   Winter daily inspection -- October to April
   Summer weekly -- April to October
   (Others as described in manual)

1. flushed
2. secondary or street
3. gate valve
4. secondary or street
5. water department
6. flow pressures
7. drained
8. flush
9. quantity
10. secondary or street

1. True
2. False
3. False
4. True
5. True
6. True
7. True
8. True
9. True
10. False
11. True

Answers for Assignment Sheet No. 6

STANDPIPE AND HOSE SYSTEMS, SPRINKLER EQUIPMENT AND AUTOMATIC ALARMS

QUESTIONS:

1. Wet system and dry system
2. Reduces the time and man power required to get hose lines into operation in buildings having large floor areas and/or those of multiple stories.
3. Six feet.
4. a. 1/2", b. 1-1/8"
5. a. Public water mains and outlets, b. Automatic fire pumps, c. Manually controlled fire pumps, d. Pressure tanks, e. Gravity tanks.
6. It is a shut off valve, generally found outside the building. It manually controls the flow of water into the sprinkler system generally supplied by the city water service mains.
7. By reading the inscription on the wall plate of each connection.
8. It consists of a series of pipes connected and interconnected, filled with water or compressed air, and with automatic devices to release the water from the system when required.
9. Drain system, close riser valve and replace heads.
10. Any flow of water from a sprinkler system equal to, or greater than that from one automatic sprinkler head will activate the alarm.

1. fire streams
2. properly located
3. outlets, effectively
4. cabinets
5. occupants, 75
6. Fire Department
7. 20
8. 60
9. reported
10. female
11. water motor, electric

1. True
2. False
3. True
4. False
5. True
6. True
7. True
8. True
9. True
10. False
11. True
12. False

Assignment Sheet No. 7

FIRE PUMPS

QUESTIONS:

1. a. Increase the pressure, b. Sole source of pressure.
2. They are capable of expelling air as well as water from the pump therefore the pump can produce sufficient vacuum for selfpriming.
3. To keep foreign materials from entering the pump.
4. a. Provide a pump of displacement type to create the vacuum, b. Utilize the vacuum naturally created in the operation of the truck engine.
5. A manually controlled by-pass between the suction and discharge side of the pump.
6. a. Pressure, b. Compound.
7. Registers the approximate direct speed in revolutions per minute at which the engine is operating.
8. It must deliver rated capacity at 150 p.s.i. net pump pressure, 70 percent of capacity at 200 p.s.i. and 50 percent of capacity at 250 p.s.i.
9. (Answer in accordance with local equipment)

1. piston, rotary gear, centrifugal
2. piston, rotary gear
3. centrifugal
4. pressure governor
5. intake, discharge
6. 200
7. portable pump
8. power, water, valve

1. False
2. False
3. True
4. True
5. True
6. False

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 8

FIRE HOSE

QUESTIONS:

1. (Answer in accordance with local equipment)
2. It causes the rubber lining within the hose to separate from the outer jacket.
3. The automatic relief valve can be reset to reduce vibration and "hose boot" may be placed underneath the hose where chafing is excessive.
4. This is done to relieve the strain on the hose connecting expansion ring, preventing the two from separating.
5. This will greatly reduce the effectiveness of the stream and increase the friction loss.
6. a. Horseshoe or U load, b. Accordian load, c. Divided load, d. combination load.
7. a. When replacing a broken section of hose, b. When extending a hose line, c. To stop the flow of water within a hose line without stopping the water at the source of supply.

1. one, pressure
2. care
3. chafing
4. bridges
5. hydrant, fire
6. improper
7. 106 pounds
8. one 50 foot section
9. parallel
10. vulcanization
11. rocker lug
12. plastic, rubber

1. True
2. False
3. False
4. False
5. True
6. True
7. True
8. False
9. True

Assignment Sheet No. 9

TOOLS AND EQUIPMENT

QUESTIONS:

1. A hydrant pump is used to remove water from the barrel of a fire hydrant to prevent the danger of having frozen hydrants in freezing weather.
2. To assure free movement and to prevent rust.
3. It saves time and eliminates errors in giving or receiving orders.
4. Paint is a good conductor of electricity and cracks that are painted over cannot be detected.
5. The motor must be the sealed or safety type which will not cause an explosion by a spark when the ejector is exposed to explosive gases.

1. cracks, splinters, head
2. breach, opened
3. wrought iron, ferrous
4. hose strap, hold, tie
5. spanner wrench

1. False
2. True
3. True
4. True
5. False

1. claw tool
2. buster bar
3. hose strap
4. hux bar
5. pull down hook
6. pick head axe
7. plaster hooks
8. hose strap
9. kelly tool
10. rope hose tool
11. crow bar
12. Detroit door opener

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 10

ROPE IN THE FIRE SERVICE

QUESTIONS:

1. Manila, sisal and hemp.
2. It will handle much easier when put into actual service.
3. a. Operate fly ladder on extension ladder, b. Hoist ladders, tools, and appliances, c. As a life line in rescue work, d. Aid in maintaining fire lines, e. Wrecking operation, f. Lash ladders together to extend the length, g. As guy lines when hoisting equipment, h. As a permanently attached hoisting line on aerial ladders.
4. The square knot is used in tying two ropes of the same size together.
5. The bowline.
6. Bowline on a bight.

1. diameter
2. seven
3. surface, inside
4. a. half hitch, b. square knot, c. clove hitch, d. bowline, e. bowline on a bight, f. chimmey hitch, g. sheep shank, h. becket knot, i. running bowline
5. short, long

1. True
2. False
3. False
4. True
5. True
6. True
7. False

Assignment Sheet No. 11

LADDERS

QUESTIONS:

1. Solid beam, trussed beam.
2. The trussed beam has increased strength in relation to weight.
3. a. Straight, b. Extension, c. Roof, d. Attic or folding, e. Aerial
4. They make the ladder safer and more reliable, even though the butt is not resting on a foundation of any type.
5. a. For beams - Douglas fir; navy specification airplane spruce
   b. For rungs - second growth hickory; ash.
6. As an aid to see the top in smoke and darkness.
7. a. Looseness, wear, slivers, cracks or checks, dry rot, need of varnish;
   b. Slivers, cracks or checks, dry rot, protective varnish, warping;
   c. Defects of metal parts, dullness of butt;
   d. Dry rot, splices, weakness and wear;
   e. Breakage, wear, lubrication, springs;
   f. Tightness, Burrs, sharp edges.
8. The distance should be one fourth of the extended length of the ladder.
9. It is a safety feature and enables men to have both hands free.

1. beam, blocks
2. extension
3. fly ladder
4. 24 foot extension
5. 10, 16
6. trailing
7. top
8. flat, beam
9. beams, rungs
10. attic, folding

1. False
2. True
3. False
4. True
5. True
6. False
7. False
8. True
9. True
10. False

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 12

GAS MASKS

QUESTIONS:

1. A breathing apparatus which provides complete respiratory protection in any concentration of toxic gases, under any condition of oxygen deficiency.
2. Masks should be worn from the time of arrival at the fire where a radiation contamination hazard exists until the hazard no longer exists. Preference indicated is for a self-contained unit.
3. a. Filter type canister mask, b. Fresh air or hose masks, c. Self-contained breathing apparatus.
4. No. It will only afford two hours of protection against carbon monoxide.
5. It provides a continuous flow in the event the automatic demand regulator becomes inoperative.
6. It releases the pressure in the breathing bag when it becomes over inflated making it difficult to exhale.

1. poisonous, toxic
2. self-contained, self-generating
3. hazard, explosion hazard
4. detect, oxygen, flame
5. liquids, vapors, withstand
6. oxygen, air
7. chemicals, fresh oxygen
8. periodically, donned

1. False
2. True
3. False
4. True
5. False
6. False
7. True
8. True
9. False

Assignment Sheet No. 13

ADVANCE INFORMATION – THE ALARM

QUESTIONS:

1. Through participation in inspections and schooling.
2. The best possible route to the scene can be taken when responding and the best course of action to take with the facilities available.
3. It will provide ready means of summoning apparatus and men to the scene of the fire.
4. By an educational program through school children, local papers, radio stations, and other media.

1. advance information, efficiently, combat
2. construction, contents
3. alarm boxes, telephone
4. maintained, designed

1. True
2. True
3. True
4. False

Assignment Sheet No. 14

SIZE-UP

QUESTIONS:

1. a. Life hazards, b. Time of the emergency, c. Location of emergency, d. Nature of emergency, e. Exposures, f. Property involved, g. The fire, h. Weather, i. Equipment and manpower available, j. Reserves available.
2. It will permit the officer in charge to be in constant contact with the entire situation and the rapid changes occurring at all times.
3. Size up is the process of making a quick analysis of the situation at hand by the person in charge.
4. a. The occupants of an involved building and all adjacent buildings.
   b. The firemen.

1. self control
2. training, experience
3. success, failure
4. interior, exterior
5. consider, utilize

1. False
2. False
3. False
4. True
5. False
6. False
7. True
8. True
9. False
10. False
11. True
12. False

Assignment Sheet No. 15

FORCIBLE ENTRY

QUESTIONS:

1. Stand to one side and strike the upper part of the glass using the flat side of a fire axe.
2. It is the most easily broken material and usually costs less to replace.
3. Insert the straight head of the Kelly tool between the door and jam, then pry toward the door.
4. They can only be raised by operating the worm gear.
5. At the center of the sash.
6. Break the glass and unlock from the inside.

1. axe, Kelly tool
2. battering ram
3. outside
4. diamond shape
5. flooring, roofing, sheathing
6. joist, rafter
7. sliding, awning, double hung

1. True
2. False
3. False
4. False
5. True
6. False

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 16

RESCUE

QUESTIONS:

1. a. Is there anyone in the building?
   b. If so, are they in danger?
   c. Have there been any crys for help?
   d. Can they be rescued?
   e. How can they be rescued?
   f. Has any information been given by persons who have escaped from the building?
   g. Has any information been given by neighbors or bystanders?
2. The rescuer should protect them by being sure that they are properly covered and their face protected. Deliver them to a competent person.
3. Place in care of a competent person.
4. If illness is not contagious, they may be taken to a neighbor's home. If contagious, provisions must be made as soon as possible to have the patient sent to a hospital. Care must be given until removal to hospital.
5. They should be placed in custody of a competent person.

1. Panic, public assembly
2. first aid
3. Weather, important
4. firemen, hazards
5. condition, trained
6. deep hole
7. sink, floating
8. steel, wrought, ferrous
9. leaks
10. electrical, wiring
11. trained
12. persons, upper
13. is not

1. True
2. True
3. False
4. False
5. True

Assignment Sheet No. 17

EXPOSURES AND CONFINEMENT

QUESTIONS:

1. Any building or material that is likely to become involved either directly or indirectly with the existing fire.
2. It is the transmission of heat by the movement of heated gases.
3. All buildings or combustible materials in danger of becoming involved from the heat of the original fire which is transmitted through conduction, radiation or convection.
4. a. Room to room on the same floor.
   b. Floor to floor in the upward extension.
   c. Floor to floor in the downward extension
   d. Building to building where adjoining.
   e. Building to building where not adjoining.
5. a. Fire resistive construction.
   b. Incombustible solid walls .
   c. Fire doors.
   d. Vertical protection.
   e. Sprinklers.
   f. Window protection.
   g. Water curtain.
6. Completely surrounding the fire with streams so that the fire will be checked at each possible avenue of extension.
7. The action necessary to contain the fire in the smallest possible area.

1. conduction, radiation, convection
2. interior, exterior
3. Metals
4. fire streams
5. fire doors
6. fire shutters, wire glass
7. air conditioning

1. True
2. False
3. True
4. False
5. True
6. True

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 18

FIRE EXTINGUISHMENT

QUESTIONS:

1.

(Method)	(How)
a. Remove fuel	Remove combustible material, shut off flammable gas or liquid covering with water curtains or water spray.
b. Reduce oxygen supply	Using inert gases to exclude oxygen such as carbon dioxide, dry chemical, foam, vaporizing liquid. Water spray turned to steam to displace oxygen.
c. Eliminate heat	Use of water to cool material below ignition temperature.

2.

(Name)	(Purpose)
a. Solid	To obtain maximum distance and penetration. Provides larger volumes of water
b. Spray	Provides greater heat absorption. Use smaller quantities of water.

3. The nozzleman must protect himself by keeping low or have some protection from the hot smoke and steam which is expelled from the room through the opening.
4. a. Feeling with the hand for hot spots.
   b. Looking for discolorations or blistering.
   c. Listening for crackling or rumbling sounds.
5. Excessive water damage must be avoided.
6. To prevent the upward spread of fire.
7. Adequate water supply, fire-fighting equipment and personnel, mutual aid contracts for additional help, effective inspection program, and a fire fighting pre-plan of operations.
8. Fireman should position themselves on the sides of the tank and never in line with the end. Whenever a tank ruptures or explodes, the contents or force is usually expelled through the ends of the tank.
9. No one should be allowed to go underneath the vehicle for extinguishing or examination purposes without blocking the body securely.
10. a. Approach the fire or gas leak from the windward side.
    b. Remove all persons in area of vapor cloud.
    c. Eliminate all sources of ignition.
    d. Evacuate any area in the path of the vapor cloud.
    e. Keep all civilian personnel at least 200 feet away from the emergency area.
11. (According to each departments equipment.)

ASSIGNMENT SHEET NO. 18 (Continued)

QUESTIONS:

1. safety, skill, good judgment
2. fuel, oxygen, heat
3. intensity, amount
4. smaller, water
5. near, possible
6. size up, decide, extinguishment
7. fire, rekindle
8. inside
9. nature, occupancy
10. cooling down
11. current, safe
12. fog, spray

1. False
2. False
3. False
4. True
5. True
6. False
7. True
8. False
9. False
10. False
11. True
12. True
13. False
14. True

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 19

VENTILATION

QUESTIONS:

1. Ventilation means opening up a building or structure in which a fire is burning.
2. a. To make entry possible, b. To prevent the spread of fire, c. To prevent "back-draft".
3. Back-draft is the explosion caused by the admission of air to a fire which has not been burning freely.
4. It is filled with smoke, heated air, and unburned gases which accumulate at the top and mushroom.
5. Smoke is a mixture of gases and fine particals of carbon.
6. Incomplete combustion due to insufficient oxygen.
7. Because free rapid burning will follow ventilation.
8. Directly above the fire if possible.
9. a. Opening too soon, b. Opening too late, c. Opening wrong place, d. Involvement of other buildings, e. Life hazards to firemen, g. Opening below the fire.
10. The extinguishment will be aided and the steam will force gas and smoke from the building.

1. exposures, contents
2. varies
3. Basements
4. safe condition

1. False
2. True
3. False
4. True
5. True
6. False
7. True
8. False
9. False
10. True
11. False

Assignment Sheet No. 20

SALVAGE

QUESTIONS:

1. Salvage is the saving of property.
2. a. The "one-man throw" fold, b. The "two-man throw" fold, or underwriter's fold, c. The accordian fold, d. The salvage cover roll and double fold.
3. a. Down elevator shafts, b. Down stairways, c. Holes cut in floor to floor, d. Chutes to outside, e. Through scuppers, f. By breaching walls.
4. 14' X 18'
5. Bathrooms and kitchens.
6. Make sure the basement floor drains are open.

1. salvage
2. Floor runners
3. wiped, dried, damage
4. one month, refolded
5. salvage, inspections
6. salvage, importance

1. True
2. False
3. True
4. False
5. True
6. False

Assignment Sheet No. 21

OVERHAUL AND PICK-UP

QUESTIONS:

1. To determine whether or not the building is a safe place in which to work.
2. Overhauling is the practice of completing operations at a fire after the main fire has been extinguished, and searching for any sparks or fire that may remain in a building.
3. a. Making sure the fire is out, b. Leaving the building in as serviceable a condition as possible.

1. equipment, first-class
2. Common sense
3. concealed
4. time, errors
5. sorted, aside

1. True
2. False
3. False
4. True
5. True
6. False
7. False

Assignment Sheet No. 22

CARE OF APPARATUS, DRIVING SUGGESTIONS, THE RUN

QUESTIONS:

1. Washing the hood while it is hot tends to affect the gloss of the finish and cause it to become dull.
2. Mud that has dried will remove the luster and destroy the finish in a short time.
3. The entire apparatus, including the chasis.
4. The varying sound pitch will attract attention more effectively.

1. clear water
2. after each run
3. reaction distance
4. reaction, braking
5. 44

1. False
2. False
3. False
4. False
5. True
6. True

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 23

POST-MORTEM CONFERENCE

QUESTIONS:

1. It is an evaluation of what has taken place during the course of the emergency or emergencies.
2. All personnel involved in the action.
3. As soon after the run as practical, because the facts will still be fresh in the minds of those who were involved in the call.
4. It will point out what can be done in the future to further expedite and obtain a more efficient operation.

1. justified, results
2. proper channels
3. change, shifts
4. pre-planning, post mortem
5. pattern

1. False
2. False
3. True
4. False
5. False

Assignment Sheet No. 24

FIRE DETECTION AND ARSON INVESTIGATION

QUESTIONS:

1. That every fire will be thoroughly investigated and the cause and the responsibility for the fire will be established.
2. It provides advance information relative to the situation upon arrival and during the course of the fire.
3. a. Color of smoke and flame, b. Odors, c. Size, intentsity and spread, d. Extinguishing methods, e. Number of fires involved, f. Evidence of cause.
4. When no logical explanation or physical evidence can be produced to indicate the fire was of accidental origin.
5. a. Preserving and safeguarding evidence, b. Records and observations, c. Court preparation.

1. investigation, arsonists
2. causes, observance, arrival
3. source, amount
4. cause
5. crime, state law
6. destruction, evidence
7. collected, marked
8. facts, conditions, situations
9. appearance, procedure

1. True
2. False
3. False
4. False
5. True
6. True
7. True
8. False
9. True
10. False

ANSWERS TO LEARNER'S WORKBOOK

Assignment Sheet No. 25

INSPECTIONS

QUESTIONS:

1. a. Aids in rescue work, b. Aids in determining fire fighting procedures, c. Aids in preventing spread of fire, d. Aids in the self preservation of firemen, e. Provides knowledge of private fire protection equipment, f. Aids in fire prevention, g. Aids in determining causes of fires, h. Stimulates cooperation between owners and occupants, and the fire department.
2. a. The fire marshal, b. Assistant fire marshals, c. Chief of fire department, d. Fire department personnel designated by the chief, e. mayor, f. Township clerk, g. Township fire prevention officer (as of October 23, 1961).
3. Unknown.
4. Horizontal spread, vertical spread, spread to exposures.
5. Good common sense, and a friendly attitude are required.
6. It will cause the owner and/or occupant to have more respect for the inspection program.
7. a. Risk involved, b. Number of hazards, c. Type of housekeeping, d. Nature of occupancy, e. Rubbish accumulations, f. Season of year, g. Department organization, h. Manpower availability.

1. life, property
2. ordinances, codes, authority
3. permits, licenses
4. administration, personnel, inspection service
5. evidence, prosecution
6. permission, requested
7. follow-up
8. qualified, lives
9. educating, fire hazards, life, property

1. False
2. True
3. False
4. True
5. False
6. True
7. False
8. False
9. True

Assignment Sheet No. 26

RADIATION HAZARDS

QUESTIONS:

1. a. Universities, b. Industrial labs., c. Industrial plants, d. Hospitals, e. Doctors' offices, f. Atomic power plants, g. Military installations, h. Transportation facilities.
2. External and Internal.
3. a. Protection from external radiation are: time, distance and shielding. b. Protection from internal radiation is to wear a self contained gas mask and protective clothing.
4. Gamma, alpha and beta.
5. a. By breathing, b. By swallowing, c. Break in skin, d. Absorption thru skin.

1. contamination
2. energy, mankind
3. sickness, resistance
4. burns, hair
5. poisoning, cancer

1. True
2. False
3. True
4. False
5. False

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